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DISCOVERY INVESTIGATIONS STATION LIST

1927–1929

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DISCOVERY INVESTIGATIONS
STATION LIST

1927–1929

(Plates I—X)

INTRODUCTION

The following lists contain particulars of all stations made by the R.R.S. 'William Scoresby' between January 1928 and the 6th of May 1929, of stations made by a member of the Discovery Investigations staff from the whaling factory S.S. 'Anglo-Norse' near the South Sandwich Islands from November 1927 to February 1928, and of stations made by another member of the staff from the whaling factory S.S. 'C. A. Larsen' in the Ross Sea from November 1928 to February 1929.

Stations made by the 'William Scoresby' are entered first and have the letters WS prefixed to their numbers. Those made near the South Sandwich Islands follow (pp. 114–123) and are distinguished as SS 1, SS 2, etc. Finally (pp. 124–131) those made in the Ross Sea are given, numbered RS 1, RS 2, etc.

Details of the nature of the data in the lists are to be found in the Introduction (pp. 3–5) of the previous Station List (vol. 1, pp. 1–140) except those noted below.

The abbreviations used in denoting the nature of the bottom, now being used by the Admiralty, are as follows:

b.	blue	G.	gravel	Po.	polyzoa
bl.	black	gn.	green	R.	rock
br.	brown	gy.	grey	S.	sand
c.	coarse	h.	hard	sm.	small
ca.	calcareous	l.	large	Sn.	shingle
Co.	coral	lt.	light	Sh.	shells
Cy.	clay	M.	mud	Sp.	sponge
d.	dark	Md.	madrepore	St.	stones
Di.	diatom	Oz.	ooze	w.	white
f.	fine	P.	pebbles	y.	yellow

∸ placed above the figure for the sounding indicates that bottom was not reached.

Estimation of hydrogen-ion concentration was made by the colorimetric method, cresol red being used as indicator with McClendon's standards. Phosphate content was again determined by Atkins' method. It was not possible to make determinations of phosphate content and hydrogen-ion concentration at the time the samples were taken. The date on which the estimations were made is entered in the "Remarks" column after the letter A (analysed), thus A 18. ix. 28, etc.

The following symbols (employed previously) are those used for nets, apparatus, etc.:

B	Oblique.
DC	Conical dredge. Mouth 16 in. in diameter (40·5 cm.), with canvas bag.
DLH	Large dredge. Heavy pattern, 4 ft. in length (1·2 m.).
H	Horizontal.
KT	Kelvin tube.
N 4–T N 7–T	Nets with mesh of 4 mm. or 7 mm. (0·16 in. or 0·28 in.) attached to back of trawl.
N 50	50 cm. tow-net. Mouth circular, 50 cm. in diameter (19·5 in.): 200 meshes to the linear inch.
N 70	70 cm. tow-net. Mouth circular, 70 cm. in diameter (27·5 in.): mesh graded, at cod-end 74 to the linear inch.
N 100	1 m. tow-net. Mouth circular, 1 m. in diameter (3·3 ft.): mesh graded, cod-end of stramin with 11–12 meshes to the linear inch.
NCS–T	Tow-net of coarse silk, with 16 meshes to the linear inch, attached to dredge, trawl, or other net.
OTC	Commercial otter trawl. Head rope 80 ft. long (24·5 m.): mesh at cod-end 1½ in. (3·8 cm.).
V	Vertical.

To the symbols for the tow-nets (N 100, N 70, N 50) B, H or V is always added to indicate the direction in which the haul was taken.

For determining the depths from which oblique nets were hauled, Kelvin tubes were constantly employed. The symbol KT in the "Remarks" column indicates their use and where it does not occur it is to be understood that the depth was estimated.

Times are expressed on the 24-hour system, the day ending with midnight (0000). The entry under "from" states the time when all the warp was paid out. That under "to" either gives the time when hauling began, or, with oblique nets, the time when the nets reached the surface. When series of vertical nets were taken only the times for the beginning and end of the series are given. The times given are "ship's time", corresponding nearly with local mean time. In order to distinguish hauls which were made when it was dark, those times which fall between sunset and sunrise are printed in heavy type.

At the end of the lists (p. 132) will be found a summary of the stations made by the 'William Scoresby' with references to the charts on which the positions are marked.

R.R.S. 'WILLIAM SCORESBY', STATIONS 137–433
SOUTH SANDWICH ISLANDS, STATIONS 1–58
ROSS SEA STATIONS 1–29

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 137	52° 08′ 00″ S, 54° 55′ 00″ W	1928 8–9 ii	2050	1538	WSW	3	SW	3	o. c.	1004·5	6·1	
WS 138	52° 36′ 00″ S, 52° 16′ 00″ W	9 ii	1700	3381	WSW	5	WSW	4	o. c.	990·0	6·1	
WS 139	53° 00′ 00″ S, 49° 50′ 00″ W	10 ii	1840	2520	W	4	W	4	o. c. q.	980·3	7·2	
WS 140	53° 17′ 00″ S, 47° 02′ 00″ W	11 ii	1535	3831	WNW	7–9	WSW	2	o. c.	986·9	5·6	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p. l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
WS 137	16–17	0	6·05	34·25	26·97	—	—	—	**N 70 V**	50–0	**2122**			
		5	6·07	34·18	26·92	—	—	—	,,	100–50				
		10	6·07	34·22	26·94	—	—	—	,,	250–90				
		20	6·03	34·22	26·95	—	—	—	,,	500–200				
		30	5·99	34·22	26·95	—	—	—	,,	500–250				
		40	5·95	34·22	26·96	—	—	—	,,	750–500				
		50	5·89	34·22	26·96	—	—	—	,,	1000–750	—	—	—	obtained successfully on fourth attempt
		75	5·86	34·31	27·05	—	—	—	**N 50 V**	100–0	—	0545		
		100	4·92	34·33	27·17	—	—	—	**N 100 B**	137–0	0616	0636	$\frac{2}{3}$	KT
		150	4·79	34·43	27·27	—	—	—	**N 70 B**					
		200	4·69	34·43	27·28									
		300	4·54	34·38	27·26									
		500	4·07	34·36	27·29									
		750	3·57	34·36	27·34									
		1000	3·15	34·36	27·38									
WS 138	17	0	6·55	34·09	26·78	—	—	—	**N 70 V**	50–0	1710			
		5	6·74	34·09	26·75	—	—	—	,,	100–50				
		10	6·79	34·10	26·76	—	—	—	,,	250–100				
		20	6·17	34·11	26·85	—	—	—	,,	500–250				
		30	6·17	34·11	26·85	—	—	—	,,	750–390				
		40	6·16	34·11	26·85	—	—	—	,,	1000–710				
		50	6·14	34·11	26·85	—	—	—	**N 50 V**	100–0	—	**2140**		
		75	6·03	34·13	26·88	—	—	—	**N 100 B**	166–0	**2210**	**2230**	$\frac{2}{3}$	KT. Net a little torn high up
		100	5·84	34·13	26·90	—	—	—	**N 70 B**					
		150	5·02	34·14	27·02									
		200	4·59	34·23	27·14									
		300	4·09	34·22	27·17									
		500	3·86	34·21	27·19									
		750	2·49	34·21	27·32									
		1000	2·60	34·30	27·38									
WS 139	18	0	6·15	34·02	26·78	—	—	—	**N 50 V**	100–0	1840			
		5	4·99	34·03	26·93	—	—	—	**N 70 V**	50–0				
		10	4·94	34·03	26·94	—	—	—	,,	100–50				
		20	4·89	34·00	26·91	—	—	—	,,	250–100				
		30	4·79	34·03	26·95	—	—	—	,,	500–200				
		40	4·69	33·99	26·93	—	—	—	,,	750–500	—	**2240**		
		50	4·17	34·00	26·99	—	—	—	**N 100 B**	161–0	**2351**	**0011**	$\frac{2}{3}$	KT. Net broken away around bucket
		75	4·09	34·00	27·00	—	—	—	**N 70 B**					
		100	3·99	34·03	27·05									
		150	3·49	34·03	27·09									
		200	3·09	34·04	27·13									
		300	—	34·05	—									
		500	2·66	34·18	27·29									
		750	2·24	34·25	27·37									
		1000	2·33	34·38	27·47									
WS 140	19	0	3·65	33·63	26·76	—	—	—	**N 70 V**	50–0	1535			
		5	3·79	33·66	26·76	—	—	—	,,	100–50				
		10	3·79	33·66	26·76	—	—	—	,,	250–90	—	1645	—	within 2–4 miles of an enormous iceberg 70 miles long. Many growlers and much loose ice
		20	4·09	33·67	26·74									
		30	4·24	33·85	26·87	—	—	—	,,	500–250	1715			
		40	4·29	33·88	26·89	—	—	—	,,	750–460				
		50	4·39	33·88	26·89	—	—	—	,,	1000–750				
		60	4·39	33·93	26·91	—	—	—	**N 50 V**	100–0	—	1930		
		80	4·39	33·98	26·96	—	—	—	**N 100 B**	111–0	**2109**	**2124**	$\frac{2}{3}$	KT
		100	2·99	34·00	27·11	—	—	—	**N 70 B**					
		150	1·49	34·03	27·26									
		200	1·39	34·05	27·27									
		300	1·62	34·20	27·38									
		400	2·09	34·38	27·49									

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 140 *cont.*	53° 17′ 00″ S, 47° 02′ 00″ W	1928 11 ii										
WS 141	53° 32′ 00″ S, 44° 52′ 00″ W	13 ii	1250	3520 M.	NNE	2	N	2	b. c.	998·9	6·1	
WS 142	53° 33′ 00″ S, 42° 03′ 00″ W	14 ii	0810	220	W	5	W	3	f. e.	984·8	5·0	
WS 143	53° 58′ 00″ S, 40° 30′ 00″ W	14–15 ii	2135	1719	NW	3	SW	3	o.	990·8	5·0	
WS 144	54° 08′ 00″ S, 36° 10′ 00″ W	19 ii	0745	279 gn. M.	SW	2	—	0	o. c.	1003·3	2·8	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
WS 140 *cont.*		500	2·28	34·43	27·52									
		750	2·19	34·57	27·63									
		1000	2·08	34·62	27·69									
		1500	1·76	34·71	27·79									
WS 141	21	0	5·15	33·82	26·75	—	—	—	**N 70 V**	50–0	1250			
		5	4·59	33·82	26·81	—	—	—	„	100–50				
		10	4·49	33·82	26·82	—	—	—	„	250–100				
		20	4·47	33·79	26·80	—	—	—	„	500–250				
		30	4·39	33·79	26·81	—	—	—	„	750–490				
		40	4·39	33·84	26·84	—	—	—	„	1000–750				
		50	4·39	33·84	26·84	—	—	—	**N 50 V**	100–0	—	1543		
		60	4·39	33·87	26·87	—	—	—	**N 100 B**	91–0	1718	1738	⅔	KT
		80	2·24	33·96	27·14	—	—	—	**N 70 B**					
		100	1·09	33·99	27·25									
		150	0·51	34·11	27·38									
		200	1·31	34·23	27·43									
		300	2·17	34·42	27·51									
		400	2·69	34·59	27·60									
		500	2·20	34·59	27·65									
		750	2·16	34·67	27·72									
		1000	2·03	34·77	27·81									
		1500	1·65	34·76	27·82									
WS 142	22	0	3·25	33·79	26·92	—	—	—	**N 70 V**	50–0	0810			
		5	2·99	33·79	26·95	—	—	—	„	100–50				
		10	2·99	33·79	26·95	—	—	—	„	210–100	—	0930		
		20	2·99	33·79	26·95	—	—	—	**N 100 B**	72–0	1017	1037	⅔	KT
		30	2·99	33·79	26·95	—	—	—	**N 70 B**					
		40	2·99	33·79	26·95									
		50	2·89	33·79	26·96									
		60	2·71	33·80	26·97									
		80	1·59	33·96	27·19									
		100	1·19	33·96	27·22									
		150	1·81	34·14	27·32									
		200	1·69	34·25	27·41									
WS 143	22–23	0	3·95	34·05	27·05	—	—	—	**N 70 V**	50–0	**2140**			
		5	3·89	34·01	27·03	—	—	—	„	100–50				
		10	3·89	34·01	27·03	—	—	—	„	250–100				
		20	3·89	34·01	27·03	—	—	—	„	500–240				
		30	3·89	34·05	27·06	—	—	—	„	750–470				
		40	3·89	34·05	27·06	—	—	—	„	1000–710				
		50	3·89	34·05	27·06	—	—	—	**N 50 V**	100–0	—	**0002**		
		60	3·79	34·05	27·07	—	—	—	**N 100 B**	130–0	**0209**	**0229**	⅔	KT
		80	2·59	34·14	27·26	—	—	—	**N 70 B**					
		100	2·39	34·14	27·28									
		150	2·31	34·14	27·29									
		200	2·19	34·14	27·29									
		300	2·81	34·23	27·32									
		400	2·89	34·35	27·41									
		500	—	34·42										
		750	2·47	34·55	27·60									
		1000	2·16	34·58	27·65									
		1500	1·99	34·74	27·79									
WS 144	28	0	2·67	33·52	26·76	—	—	—	**N 70 V**	50–0	0745			
		5	2·79	33·49	26·72	—	—	6·80	„	100–50				
		10	2·79	33·51	26·74	—	—	—	„	270–100				
		20	2·79	33·51	26·74	—	—	6·95	**N 50 V**	100–0	—	0845		
		30	2·79	33·51	26·74	—	—	—	**N 100 B**	73–0	0954	1014	⅔	KT
		40	2·79	33·51	26·74	—	—	6·92	**N 70 B**					

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 144 *cont.*	54° 08′ 00″ S, 36° 10′ 00″ W	1928 19 ii										
WS 145	54° 00′ 00″ S, 36° 00′ 00″ W	19 ii	1135	287 gn. M.	NW	4	NW	3	o. c.	1003·0	2·8	
WS 146	53° 50′ 00″ S, 35° 50′ 00″ W	19 ii	1505	1096	NW	6	NW	4	o. c. q.	996·0	2·2	
WS 147	53° 50′ 00″ S, 35° 50′ 00″ W	21 ii	2030	274 M.	NW	2	NW	2	—	996·7	10·0	
WS 148	53° 40′ 00″ S, 35° 35′ 00″ W	22 ii	0410	—	WNW	2	WNW	2	o. c.	992·4	1·7	
WS 149	53° 32′ 00″ S, 35° 22′ 00″ W	22 ii	0615	3009 gy. M. St.	WNW	3	WNW	3	o. c.	991·0	1·7	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME From	TIME To	Length of tow (miles)	
WS 144 *cont.*		50	2·81	33·47	26·70									
		60	2·69	33·49	26·73	—	—	6·93						
		80	1·49	33·61	26·92									
		100	0·77	33·78	27·09	—	—	6·72						
		150	0·34	33·95	27·26	—	—	6·32						
		200	0·59	34·14	27·27	—	—	5·52						
		250	1·19	34·27	27·34	—	—	4·74						
WS 145	28	0	3·55	33·53	26·68	—	—	—	**N 50 V**	100–0	1135			
		5	2·19	33·57	26·83	—	—	7·00	**N 70 V**	50–0				
		10	2·09	33·58	26·85	—	—	—	,,	100–50				
		20	2·07	33·58	26·85	—	—	7·08	,,	275–100	—	1210		
		30	2·16	33·56	26·84	—	—	—	**N 100 B**	80–0	1330	1350	⅔	KT
		40	1·96	33·55	26·84	—	—	7·02	**N 70 B**					
		50	1·16	33·69	27·00									
		60	0·76	33·71	27·04	—	—	6·77						
		80	0·52	33·87	27·19									
		100	0·29	33·96	27·27	—	—	6·27						
		150	0·59	34·15	27·28	—	—	5·87						
		200	1·14	34·26	27·33	—	—	4·89						
		250	1·59	34·45	27·58	—	—	4·13						
WS 146	28	0	2·00	33·22	26·57	—	—	—	**N 70 V**	50–0	1507			
		5	1·22	33·47	26·82	—	—	6·95	,,	100–50				
		10	1·15	33·48	26·83	—	—	—	,,	250–100				
		20	1·13	33·51	26·86	—	—	6·95	,,	500–250				
		30	1·14	33·48	26·83	—	—	—	,,	750–500				
		40	1·19	33·49	26·84	—	—	7·26	,,	1000–750				
		50	1·14	33·49	26·84	—	—	—	**N 50 V**	100–0	—	1817		
		60	0·89	33·58	26·93	—	—	6·96						
		80	0·19	33·81	27·16									
		100	0·16	33·97	27·29	—	—	6·12						
		150	1·16	34·25	27·45	—	—	5·10						
		200	1·50	34·39	27·52	—	—	4·83						
		300	1·79	34·49	27·59	—	—	4·19						
		400	1·89	34·58	27·67	—	—	3·99						
		500	1·97	34·54	27·63	—	—	4·14						
		750	2·00	34·63	27·70	—	—	3·57						
		1000	1·90	34·70	27·77	—	—	3·46						
WS 147	0	0	2·40	33·58	26·82	—	—	—	**N 70 V**	50–0	**2120**			
		5	2·09	33·58	26·86	—	—	6·67	,,	100–50				
		10	2·14	33·58	26·86	—	—	—	,,	250–100				
		20	2·09	33·58	26·86	—	—	6·60	**N 50 V**	100–0	—	**2310**		
		30	2·10	33·58	26·86	—	—	—	**N 100 B**	100–0	**2040**	**2100**	⅔	KT
		40	2·03	33·60	26·88	—	—	6·70	**N 70 B**					
		50	—	33·80										
		60	0·29	33·87	27·20	—	—	6·25						
		80	0·19	33·95	27·25									
		100	0·29	33·97	27·28	—	—	5·91						
		150	1·10	34·20	27·41	—	—	5·04						
		200	1·14	34·36	27·54	—	—	4·32						
		250	1·30	34·40	27·55	—	—	4·18						
WS 148	1	—	—	—	—	—	—	—	**N 100 B**	99–0	**0433**	**0453**	⅔	KT
									N 70 B					
WS 149	1	0	1·30	33·51	26·85	—	—	—	**N 70 V**	50–0	0617			
		5	1·02	33·46	26·82	—	—	6·86	,,	100–50				
		10	1·02	33·51	26·87	—	—	—	,,	250–100				
		20	0·99	33·51	26·87	—	—	6·66	,,	500–250				
		30	0·84	33·51	26·87	—	—	—	,,	750–500				

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 149 *cont.*	53° 32′ 00″ S, 35° 22′ 00″ W	1928 22 ii										
WS 150	53° 23′ 00″ S, 35° 15′ 00″ W	22 ii	1210	—	NW	3	NW	3	f. r.	990·7	2·2	
WS 151	53° 17′ 00″ S, 35° 08′ 00″ W	22 ii	1415	3841	NW	6	NW	4	f. e.	986·2	2·2	
WS 152	53° 12′ 00″ S, 34° 52′ 00″ W	22 ii	1955	—	NW	6	NW	5	o. q. f.	985·9	1·7	
WS 153	54° 02′ 00″ S, 35° 30′ 00″ W	23 ii	1022	—	WNW	4	WNW	4	b.	994·2	2·8	
WS 154	54° 00′ 00″ S, 36° 52′ 00″ W	26 ii	1316	206 M.	NNW	6	NNW	5	o. q.	995·9	5·0	
WS 155	53° 50′ 00″ S, 36° 52′ 00″ W	26 ii	1634	—	WNW	7	NW	4	o. q.	1000·3	3·3	
WS 156	53° 40′ 00″ S, 36° 52′ 00″ W	26 ii	1825	220 gy. M. St.	WNW	7	NW	4	o. q.	998·4	3·3	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
WS 149		40	0·79	33·51	26·88	—	—	6·79	**N 70 V**	1000–750				
cont.		50	0·78	33·53	26·89	—	—	—	**N 50 V**	100–0	—	0915		
		60	0·53	33·62	26·99	—	—	6·43	**N 100 B**	103–0	1021	1041	⅔	KT
		80	0·31	33·64	27·01	—	—	—	**N 70 B**					
		100	0·19	33·87	27·20	—	—	6·16						
		150	0·13	34·15	27·44	—	—	5·55						
		200	1·03	34·34	27·53	—	—	4·47						
		300	1·59	34·52	27·64	—	—	3·97						
		400	1·88	34·63	27·71	—	—	3·87						
		500	1·95	34·68	27·74	—	—	3·62						
		750	1·83	34·72	27·78	—	—	4·02						
		1000	1·58	34·76	27·83	—	—	3·82						
WS 150	1	—	—	—	—	—	—	—	**N 100 B**	65–0	1215	1235	⅔	KT
									N 70 B					
WS 151	1	0	1·30	33·48	26·82	—	—	—	**N 70 V**	50–0	1420			
		5	0·98	33·44	26·81	—	—	7·33	,,	100–50				
		10	0·98	33·45	26·82	—	—	—	,,	250–100				
		20	0·94	33·45	26·82	—	—	7·31	,,	500–250				
		30	0·99	33·45	26·82	—	—	—	,,	750–450				
		40	0·89	33·46	26·83	—	—	7·25	,,	1000–750				
		50	0·89	33·46	26·83	—	—	—	**N 50 V**	100–0				
		60	0·79	33·47	26·84	—	—	7·31	**N 100 B**	88–0	1827	1847	⅔	KT
		80	0·09	33·77	27·11	—	—	—	**N 70 B**					
		100	− 0·01	33·96	27·29	—	—	6·27						
		150	0·79	34·22	27·44	—	—	5·42						
		200	1·50	34·36	27·51	—	—	4·58						
		300	1·51	34·51	27·63	—	—	4·34						
		400	1·77	34·63	27·72	—	—	4·12						
		500	1·89	34·67	27·74	—	—	3·97						
		750	1·82	34·71	27·78	—	—	3·70						
		1000	1·47	34·76	27·84	—	—	4·10						
WS 152	1	—	—	—	—	—	—	—	**N 100 B**	110–0	**2003**	**2023**	⅔	KT
									N 70 B					
WS 153	2	—	—	—	—	—	—	—	**N 100 B**	104–0	1031	1051	⅔	KT
									N 70 B					
WS 154	5	0	2·38	33·49	26·76	—	—	—	**N 50 V**	100–0	1316			
		5	2·33	33·49	26·76	—	—	—	**N 70 V**	50–0				
		10	2·29	33·49	26·76	—	—	—	,,	100–50	—	1427		
		20	2·19	33·49	26·77	—	—	—	**N 100 B**	115–0	1509	1529	⅔	KT
		30	1·98	33·51	26·81	—	—	—	**N 70 B**					
		40	1·13	33·67	26·98									
		50	0·79	33·77	27·08									
		60	0·59	33·82	27·14									
		80	0·40											
		100	0·37	33·87	27·20									
		150	0·33	33·84	27·17									
WS 155	5	—	—	—	—	—	—	—	**N 100 B**	98–0	1642	1702	⅔	KT
									N 70 B					
WS 156	5	0	—	33·48	—	—	—	—	**N 50 V**	100–0	**1910**			
		5	2·31	33·48	26·75	—	—	—	**N 70 V**	50–0				
		10	2·29	33·49	26·76	—	—	—	,,	100–50				
		20	2·25	33·50	26·78	—	—	—	,,	200–100	—	**2012**		
		30	2·29	33·56	26·82	—	—	—	**N 100 B**	82–0	1839	1859	⅔	KT
		40	2·29	33·50	26·77	—	—	—	**N 70 B**					
		50	2·33	33·68	26·91									

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 156 *cont.*	53° 40′ 00″ S, 36° 52′ 00″ W	1928 26 ii										
WS 157	53° 30′ 00″ S, 36° 52′ 00″ W	27 ii	0750	—	NW	3	NW	4	f.	993·4	2·8	
WS 158	53° 20′ 00″ S, 36° 52′ 00″ W	27 ii	0950	1042	NNW	3	NNW	3	f.	994·2	2·8	
WS 159	53° 10′ 00″ S, 36° 52′ 00″ W	27 ii	1348	—	NNW	3	NNW	3	f.	994·2	2·8	
WS 160	53° 00′ 00″ S, 36° 52′ 00″ W	27 ii	1520	3182 gy. M. St.	SW	1	NW	0	f.	992·1	1·7	slight swell
WS 161	52° 50′ 00″ S, 36° 52′ 00″ W	27 ii	1958	—	SW	4	—	—	o. g.	—	1·1	sea conf.
WS 162	53° 42′ 00″ S, 36° 17′ 00″ W	28 ii	0850	—	SW × S	4	SW	3	o. g. r.	999·4	4·1	
WS 163	53° 54′ S, 38° 18′ W	29 ii	1548	98 R.	NNE	6	NNE	5	o. q. r.	992·4	4·4	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p. l.	Gear	Depth (metres)	TIME From	TIME To	Length of tow (miles)	
WS 156 *cont.*		60	1·37	33·68	27·03									
		80	0·31	33·90	27·22									
		100	0·24	33·98	27·30									
		150	0·59	34·14	27·40									
		200	0·97	34·35	27·55									
WS 157	6	—	—	—	—	—	—	—	**N 100 B**	84–0	0800	0820	$\frac{2}{3}$	KT
									N 70 B					
WS 158	6	0	2·55	33·55	26·79	—	—	—	**N 50 V**	100–0	1027			
		5	2·48	33·55	26·80	—	—	—	**N 70 V**	50–0				
		10	2·44	33·56	26·81	—	—	—	,,	100–50				
		20	2·43	33·56	26·81	—	—	—	,,	250–100				
		30	2·42	33·56	26·81	—	—	—	,,	500–250	—	1233		
		40	2·41	33·56	26·81	—	—	—	**N 100 B**	77–0	0958	1018	$\frac{2}{3}$	KT
		50	2·41	33·52	26·78	—	—	—	**N 70 B**					
		60	2·39	33·56	26·81									
		70	1·87	33·62	26·91									
		80	0·38	33·78	27·12									
		100	0·19	33·90	27·22									
		150	1·09	34·20	27·41									
		200	1·57	34·31	27·47									
		300	1·99	34·47	27·57									
		400	2·07	34·53	27·61									
		500	2·10	34·63	27·69									
WS 159	6	—	—	—	—	—	—	—	**N 100 B**	104–0	1355	1415	$\frac{2}{3}$	KT
									N 70 B					
WS 160	6	0	2·45	33·56	26·80	—	—	—	**N 50 V**	100–0	1600			
		5	2·22	33·56	26·83	—	—	—	**N 70 V**	50–0				
		10	2·19	33·56	26·83	—	—	—	,,	100–50				
		20	2·18	33·56	26·83	—	—	6·86	,,	250–100				
		30	2·17	33·58	26·84	—	—	—	,,	500–250	—	1723		
		40	2·16	33·59	26·87	—	—	7·02	**N 100 B**	128–0	1534	1554	$\frac{2}{3}$	KT
		50	2·16	33·59	26·87	—	—	—	**N 70 B**					
		60	2·17	33·60	26·86									
		80	1·89	33·64	26·92									
		90	0·31	33·82	27·13									
		100	0·19	33·83	27·18	—	—	6·77						
		150	0·59	34·16	27·41	—	—	5·61						
		200	1·59	34·34	27·49	—	—	4·64						
		300	1·89	34·52	27·62	—	—	4·03						
		400	1·95	34·58	27·66	—	—	4·18						
		500	1·98	34·63	27·70	—	—	4·02						
WS 161	6	—	—	—	—	—	—	—	**N 100 B**	104–0	**2004**	**2024**	$\frac{2}{3}$	KT
									N 70 B					
WS 162	7	—	—	—	—	—	—	—	**N 100 B**	93–0	0858	0918	$\frac{2}{3}$	KT
									N 70 B					
WS 163	8	0	2·00	33·63	26·91	—	—	—	**N 70 V**	50–0	1550			
		5	1·88	33·63	26·92	—	—	6·93	,,	80–50				
		10	1·79	33·63	26·92	—	—	—	**N 50 V**	85–0	—	1623		
		20	1·72	33·60	26·90	—	—	6·85	**N 100 B**	90–0	1713	1726	$\frac{2}{5}$	KT
		30	1·70	33·68	26·95	—	—	—	**N 70 B**					
		40	1·59	33·68	26·96	—	—	6·90						
		50	1·47	33·69	26·98									
		60	1·40	33·72	27·01	—	—	6·87						
		80	0·70	33·82	27·14									
		90	0·46	33·86	27·17	—	—	6·58						

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 164	53° 49′ S, 38° 32′ W	1928 29 ii	1842	153 R.	NE	6	NE	6	o. q. r.	992·4	3·3	
WS 165	53° 44′ S, 38° 46′ W	1 iii	0130	164 gn. M.	NE	4–5	NE	4	f.	987·2	2·7	
WS 166	53° 36′ S, 39° 08′ W	1 iii	0530	153	W	3	W	2	b. c.	985·9	3·3	
WS 167	53° 31′ S, 39° 22′ W	1 iii	0845	740	W	3–5	W	3–5	o.	986·4	3·3	
WS 168	53° 26′ S, 39° 36′ W	1 iii	1310	2496 gy. M.	W × N	9	W × N	6	o. q. r.	985·2	3·9	
WS 169	54° 36′ 00″ S, 35° 40′ 00″ W	6 iii	1145	114 gy. M.	S	3	S	3	v. c.	993·4	8·3	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS Depth (metres)	Temp. ° Cent.	S ‰	σ_t	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p. l.	BIOLOGICAL OBSERVATIONS Gear	Depth (metres)	TIME From	TIME To	Length of tow (miles)	Remarks
WS 164	8	0	2·40	33·58	26·82	—	—	—	N 100 B	104–0	1853	1913	⅔	KT
		5	2·10	33·62	26·89	—	—	7·03	N 70 B					
		10	2·23	33·60	26·86	—	—	—	N 50 V	100–0	1933			
		20	2·09	33·64	26·90	—	—	7·00	N 70 V	50–0				
		30	2·09	33·62	26·89	—	—	—	,,	100–50				
		40	1·89	33·66	26·93	—	—	6·95	,,	140–100	—	2118		
		50	1·59	33·68	26·96									
		60	1·18	33·75	27·05	—	—	6·74						
		80	0·29	33·95	27·26									
		100	0·19	33·96	27·28	—	—	6·00						
		140	0·24	33·98	27·30	—	—	5·90						
WS 165	10	0	2·48	33·63	26·87	—	—	—	N 50 V	100–0	0145			
		5	2·23	33·58	26·85	—	—	6·90	N 70 V	50–0				
		10	2·25	33·59	26·86	—	—	—	,,	100–50				
		20	2·19	33·59	26·86	—	—	6·96	,,	150–100	—	0240		
		30	2·19	33·59	26·86	—	—	—	N 100 B	133–0	0341	0404	⅘	KT
		40	2·19	33·58	26·85	—	—	7·01	N 70 B					
		50	2·02	33·56	26·85									
		60	0·82	33·75	27·07	—	—	6·62						
		80	0·29	33·87	27·19									
		100	0·27	33·98	27·29	—	—	6·09						
		150	0·38	34·00	27·30	—	—	6·26						
WS 166	10	0	2·35	33·65	26·89	—	—	—	N 50 V	100–0	0535			
		5	2·19	33·65	26·90	—	—	—	N 70 V	50–0				
		10	2·15	33·65	26·91	—	—	—	,,	100–50				
		20	2·16	33·65	26·91	—	—	—	,,	140–100	—	0613		
		30	2·12	33·66	26·91	—	—	—	N 100 B	97–0	0659	0719	⅔	KT
		40	2·09	33·68	26·93	—	—	—	N 70 B					
		50	2·10	33·72	26·97									
		60	2·06	33·72	26·97									
		80	0·53	33·89	27·20									
		100	0·41											
		150	0·78	34·23	27·46									
WS 167	10	0	2·85	33·71	26·89	—	—	—	N 50 V	100–0	0901			
		5	2·49	33·71	26·92	—	—	—	N 70 V	50–0				
		10	2·49	33·69	26·90	—	—	—	,,	100–50				
		20	2·48	33·72	26·93	—	—	—	,,	250–100				
		30	2·41	33·72	26·94	—	—	—	,,	460–250	—	1015	—	net touched bottom
		40	2·47	33·70	26·91	—	—	—	N 100 B	104–0	1115	1135	⅔	KT
		50	2·09	33·73	26·96	—	—	—	N 70 B					
		60	1·49	33·73	27·01									
		80	0·59	33·91	27·21									
		100	0·48	33·92	27·23									
		150	0·89	34·18	27·42									
		200	1·29	34·32	27·50	—	—	4·68						
		300	1·89	34·52	27·62	—	—	4·26						
WS 168	10	—	—	—	—	—	—	—	N 50 V	100–0	1315			
									N 70 V	50–0				
									,,	100–50				
									,,	250–100	—	1415		
WS 169	14	0	2·80	33·28	26·56	—	—	—	N 50 V	100–0	1150			
		5	2·61	33·29	26·58	—	—	—	N 70 V	50–0				
		10	2·41	33·23	26·56	—	—	—	,,	100–50	—	1235		
		20	2·39	33·27	26·58	—	—	—	N 100 B	98–0	1256	1314	⅗	KT
		30	2·24	33·27	26·59	—	—	—	N 70 B					
		40	1·95	33·45	26·76									
		50	1·88	33·46	26·77									

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 169 *cont.*	54° 36′ 00″ S, 35° 40′ 00″ W	1928 6 iii										
WS 170	54° 36′ 00″ S, 35° 18′ 00″ W	6 iii	1424	—	S	3	S	3	v. c.	993·4	8·3	
WS 171	54° 36′ 00″ S, 35° 00′ 00″ W	6 iii	1600	274 R.	E × N	5	E × N	5	o. c. d.	993·6	2·8	
WS 172	54° 36′ 00″ S, 34° 50′ 00″ W	6 iii	1907	—	NNE	2	—	0	o. c. d.	993·6	2·8	
WS 173	54° 36′ 00″ S, 34° 25′ 00″ W	6–7 iii	2145	1243 gy. M. sm. P.	NNE	1	—	0	o. c. m.	993·4	2·2	
WS 174	54° 36′ 00″ S, 34° 08′ 00″ W	7 iii	0123	—	NNE	1	—	0	o. c. m.	993·4	2·2	
WS 175	54° 36′ 00″ S, 33° 50′ 00″ W	7 iii	0255	2578	N	3	N	3	o. c.	988·0	1·1	
WS 176	54° 36′ 00″ S, 33° 35′ 00″ W	7 iii	0720	—	N	3	N	3	o. c.	988·0	1·1	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
WS 169 *cont.*		60	1·71	33·46	26·78									
		80	1·39	33·55	26·88									
		100	0·99	33·62	26·96									
WS 170	14	—	—	—	—	—	—	—	**N 100 B**	95–0	1431	1451	$\frac{2}{3}$	KT
									N 70 B					
WS 171	14	0	2·35	33·66	26·89	—	—	—	**N 70 V**	50–0	1605			
		5	2·19	33·64	26·89	—	—	—	,,	100–50				
		10	2·09	33·64	26·90	—	—	—	,,	250–100				
		20	2·07	33·65	26·91	—	—	—	**N 50 V**	100–0	—	1749		
		30	2·04	33·65	26·92	—	—	—	**N 100 B**	82–0	1724	1745	$\frac{2}{3}$	KT
		40	2·03	33·66	26·92	—	—	—	**N 70 B**					
		50	2·02	33·68	26·93									
		60	1·99	33·69	26·94									
		80	1·99	33·71	26·94									
		100	1·01	33·82	27·12									
		150	0·73	34·07	27·34									
		200	0·85	34·25	27·47									
		250	1·17	34·41	27·58									
WS 172	14	—	—	—	—	—	—	—	**N 100 B**	109–0	**2001**	**2021**	$\frac{2}{3}$	KT
									N 70 B					
WS 173	14–15	0	2·45	33·71	26·92	—	—	—	**N 50 V**	100–0	**2155**			
		5	2·33	33·69	26·91	—	—	—	**N 70 V**	50–0				
		10	2·29	33·68	26·91	—	—	—	,,	100–50				
		20	2·31	33·68	26·91	—	—	—	,,	250–100				
		30	2·26	33·68	26·91	—	—	—	,,	500–250	—	**2300**		
		40	2·24	33·69	26·92	—	—	—	**N 100 B**	102–0	**2351**	**0012**	$\frac{2}{3}$	KT
		50	1·89	33·91	27·13	—	—	—	**N 70 B**					
		60	1·00	34·02	27·28									
		80	0·84	34·09	27·34									
		100	1·11	34·16	27·38									
		150	1·15	34·16	27·38									
		200	2·19	34·42	27·52									
		300	2·09	34·49	27·59									
		400	2·09	34·53	27·61									
		500	2·09	34·63	27·69									
WS 174	15	—	—	—	—	—	—	—	**N 100 B**	102–0	**0130**	**0150**	$\frac{2}{3}$	KT
									N 70 B					
WS 175	15	0	1·70	33·55	26·86	—	—	—	**N 50 V**	100–0	**0305**			
		5	1·56	33·49	26·82	—	—	7·11	**N 70 V**	50–0				
		10	1·51	33·50	26·83	—	—	—	,,	100–50				
		20	1·44	33·53	26·85	—	—	7·04	,,	250–100				
		30	1·33	33·55	26·88	—	—	—	,,	500–250	—	**0431**		
		40	1·32	33·55	26·88	—	—	7·06	**N 100 B**	103–0	0553	0613		
		50	1·19	33·64	26·96	—	—	—	**N 70 B**					
		60	0·79	33·78	27·09	—	—	6·79						
		80	0·81	34·11	27·36									
		100	0·79	34·18	27·42	—	—	5·89						
		150	1·37	34·27	27·45	—	—	4·98						
		200	1·49	34·34	27·50	—	—	4·66						
		300	1·98	34·48	27·58	—	—	3·98						
		400	1·84	34·58	27·67	—	—	3·90						
		500	1·85	34·67	27·74	—	—	3·99						
WS 176	15	—	—	—	—	—	—	—	**N 100 B**	98–0	0731	0752	$\frac{2}{3}$	KT
									N 70 B					

Station	Position	Date	Hour	Sounding (metres)	WIND Direction	WIND Force	SEA Direction	SEA Force	Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
WS 177	54° 58′ 00″ S, 35° 00′ 00″ W	1928 7 iii	1320	—	N	3	N	2	c. o. p.	988·7	2·8	
WS 178	10 miles SE of Cooper Island, South Georgia	7 iii	1538 1726	73 137	SW	3	SW	2	o. c. m.	994·4	3·3	
WS 179	55° 08′ 00″ S, 35° 20′ 00″ W	7 iii	1833	125 M. St. Sh.	SW	5	SW	5	o. c.	994·6	2·8	
WS 180	55° 18′ 00″ S, 35° 10′ 00″ W	7 iii	2130	150 M.	SW	5	SW	5	o. c.	994·6	2·8	
WS 181	55° 25′ 00″ S, 35° 00′ 00″ W	8 iii	0035	—	SW	2	SW	2	b. c.	998·2	2·2	
WS 182	55° 30′ 00″ S, 34° 50′ 00″ W	8 iii	0315 0715	878 1048	SW	2	SW	2	b. c. v.	1001·2	2·8	
WS 183	55° 36′ 00″ S, 34° 40′ 00″ W	8 iii	0830	—	SW	2	SW	2	o. c.	1003·0	3·3	
WS 184	55° 12′ 00″ S, 37° 50′ 00″ W	8 iii	1907	—	—	0	—	0	b.	1007·2	3·3	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
WS 177	15	—	—	—	—	—	—	—	N 100 B N 70 B	97–0	1339	1400	⅔	touched bottom. KT
WS 178	15	0	2·55	33·52	26·77	—	—	—	N 70 V	50–0	1545			
		5	2·40	33·51	26·77	—	—	6·96	,,	100–50				
		10	2·46	33·49	26·75	—	—	—	N 50 V	100–0	—	1617		
		20	2·43	33·49	26·75	—	—	6·98	N 100 B N 70 B	122–0	1701	1722	⅔	KT
		30	2·51	33·50	26·75	—	—	—						
		40	2·41	33·49	26·75	—	—	6·92						
		50	2·37	33·49	26·76									
		60	2·38	33·49	26·76	—	—	6·96						
		80	2·14	33·49	26·78									
		100	1·95	33·68	26·93	—	—	6·69						
WS 179	15	0	2·50	33·52	26·77	—	—	—	N 70 V	50–0	1835			
		5	2·44	33·51	26·77	—	—	6·93	,,	100–50				
		10	2·49	33·49	26·75	—	—	—	N 50 V	100–0	—	**1929**	—	many icebergs in vicinity
		20	2·44	33·49	26·75	—	—	6·95	N 100 B N 70 B	112–0	**2006**	**2025**	⅔	KT
		30	2·51	33·50	26·75	—	—	—						
		40	2·43	33·50	26·76	—	—	6·90						
		50	2·35	33·49	26·76									
		60	2·42	33·49	26·75	—	—	6·94						
		80	2·31	33·49	26·76									
		100	2·25	33·66	26·90	—	—	6·78						
WS 180	15	0	2·40	33·55	26·80	—	—	—	N 50 V	100–0	**2130**			
		5	2·48	33·50	26·76	—	—	6·95	N 70 V	50–0				
		10	2·42	33·50	26·76	—	—	—	,,	100–50	—	**2220**		
		20	2·41	33·51	26·77	—	—	7·10	N 100 B N 70 B	79–0	**2301**	**2319**	⅔	KT
		30	2·47	33·51	26·77	—	—	—						
		40	2·55	33·51	26·76	—	—	6·83						
		50	2·49	33·55	26·80									
		60	2·39	33·57	26·81	—	—	6·82						
		80	2·24	33·64	26·89									
		100	2·01	33·69	26·95	—	—	6·58						
WS 181	16	—	—	—	—	—	—	—	N 100 B	91–0	**0051**	**0114**	⅔	KT
									N 70 B	110–0	**0134**	**0154**	⅔	KT
WS 182	16	0	2·70	33·77	26·94	—	—	—	N 100 B N 70 B	99–0	**0327**	**0347**	⅔	KT
		5	2·62	33·74	26·93	—	—	6·86						
		10	2·62	33·76	26·95	—	—	—	N 70 V	50–0	**0355**			
		20	2·62	33·76	26·95	—	—	6·91	,,	100–50				
		30	2·61	33·76	26·95	—	—	—	,,	250–100				
		40	2·61	33·76	26·95	—	—	6·93	,,	500–250				
		50	2·59	33·76	26·95	—	—	—	,,	750–520				
		60	1·89	33·86	27·08	—	—	6·85	,,	1000–750				
		80	0·51	34·06	27·37	—	—	—	N 50 V	100–0	—	0715		
		100	0·49	34·19	27·45	—	—	6·35						
		150	1·27	34·27	27·46	—	—	5·50						
		200	1·89	34·40	27·52	—	—	4·62						
		300	2·09	34·48	27·57	—	—	4·04						
		400	2·09	34·63	27·68	—	—	3·76						
		500	2·15	34·71	27·76	—	—	3·72						
		750	2·16	34·65	27·70	—	—	3·64						
		1000	2·07	34·67	27·72	—	—	3·86						
WS 183	16	—	—	—	—	—	—	—	N 100 B N 70 B	104–0	0842	0902	⅔	KT
WS 184	16	—	—	—	—	—	—	—	N 100 B	98–0	**1915**	**1936**	⅔	KT
									N 70 B	89–0	**2002**	**2022**	⅔	KT

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 185	55° 06′ 00″ S, 37° 30′ 00″ W	1928 8 iii	2104	—	—	0	—	0	b.	1007·2	3·3	
WS 186	54° 55′ 00″ S, 37° 10′ 00″ W	8 iii	2224	—	—	0	—	0	o. c. m.	1007·2	2·8	
WS 187	54° 50′ 00″ S, 37° 05′ 00″ W	8–9 iii	2355	—	—	0	—	0	o. c. m.	1007·2	2·8	
WS 188	54° 42′ 00″ S, 36° 55′ 00″ W	9 iii	0125	—	—	—	—	0	f. (2) q.	1007·2	2·8	
WS 189	53° 30′ 00″ S, 38° 35′ 00″ W	9 iii	2035	293 M.	NE	6	NE	4	o. r. f.	1005·4	2·2	
WS 190	55 miles NW of Bird I, S Georgia	10 iii	0115	2158	—	0	—	0	o. m. v. (2)	1001·2	3·3	
WS 191	65 miles NW of Bird I, S Georgia	10 iii	0920	—	—	0	—	0	o. m. (3)	—	3·3	
WS 192	From 54° 22′ 06″ S, 38° 30′ 00″ W to 54° 08′ 18″ S, 38° 26′ 42″ W	10–11 iii	2045 — 0330	200	—	0	—	0	o. c. m. (3)	997·0	2·8	
WS 193	53° 42′ 00″ S, 38° 28′ 00″ W	11 ii	0820	—	SSW	3	SSW	3	c.	1001·2	3·3	
WS 194	From 53° 23′ 00″ S, 37° 10′ 00″ W to 53° 03′ 00″ S, 36° 52′ 00″ W	11–12 iii	1445 — 0410	—	—	0	—	0	o. c.	1003·3	2·2	
WS 195	From 54° 00′ 00″ S, 34° 45′ 00″ W to 53° 42′ 00″ S, 34° 10′ 00″ W	12–13 iii	1800 — 0540	—	ESE	3	ESE	2	c.	1004·2	2·2	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME From	TIME To	Length of tow (miles)	
WS 185	16	—	—	—	—	—	—	—	N 100 B N 70 B	86–0	2113	2133	⅔	KT
WS 186	16	—	—	—	—	—	—	—	N 100 B N 70 B	95–0	2236	2257	⅔	KT
WS 187	16–17	—	—	—	—	—	—	—	N 100 B N 70 B	86–0	0013	0033	⅔	KT
WS 188	17	—	—	—	—	—	—	—	N 100 B N 70 B	119–0	0154	0214	⅔	KT
WS 189	17	—	—	—	—	—	—	—	N 50 V	100–0	2035			
									N 70 V	50–0	—	2100		
WS 190	18	0	2·65	33·62	26·84	—	—	—	N 50 V	100–0	0145			
		5	2·49	33·58	26·82	—	—	6·88	N 70 V	50–0				
		10	2·41	33·60	26·84	—	—	—	,,	100–50				
		20	2·39	33·65	26·88	—	—	7·03	,,	250–100				
		30	2·29	33·65	26·89	—	—	—	,,	500–250				
		40	2·19	33·59	26·86	—	—	7·05	,,	750–500				
		50	2·19	33·56	26·83	—	—	—	,,	1000–750	—	0710	—	net very slightly torn
		60	1·99	33·64	26·91	—	—	6·86	N 100 B N 70 B	110–0	0739	0800	⅔	KT
		70	1·25	33·69	26·99	—	—	—						
		80	0·59	33·72	27·20	—	—	—						
		100	0·33	34·18	27·45	—	—	6·25						
		150	0·95	34·29	27·49									
		200	1·98	34·34	27·46	—	—	4·88						
		300	2·00	34·51	27·60	—	—	4·08						
		400	1·99	34·58	27·66	—	—	3·83						
		500	2·07	34·77	27·80	—	—	3·65						
		750	1·98	34·73	27·78	—	—	4·08						
		1000	1·79	34·74	27·80	—	—	3·96						
WS 191	18	—	—	—	—	—	—	—	N 100 B N 70 B	100–0	0931	0952	⅔	KT
WS 192	18–19	—	—	—	—	—	—	—	N 100 H	0–5	2045	2100	½	27 consecutive hauls (A–AA) each of 15 mins. duration. Sunset 1839; sunrise 0543
									,,	,,	0300	0315		
WS 193	19	—	—	—	—	—	—	—	N 100 B N 70 B	108–0	0853	0916	⅔	KT
WS 194	19–20	—	—	—	—	—	—	—	N 100 B	100–0	1625	1645		23 consecutive oblique hauls (A–W) each of 20 mins. duration. Sunset 1835; sunrise 0545
									,,	,,	0350	0410		
WS 195	20–21	—	—	—	—	—	—	—	N 100 B	—	1814	1836	—	26 consecutive oblique hauls (A–Z) each of 20 mins. duration. Sunset 1834; sunrise 0546
									,,	102–0	1917	1936		
									,,	86–0	2212	2232		
									,,	78–0	0045	0105		
									,,	104–0	0332	0350		
									,,	—	0523	0540		

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 196	54° 36′ 00″ S, 38° 38′ 00″ W	1928 14 iv	1640	235 gn. M.	NW	2	NW	—	o. c.	975·1	3·3	slight NW swell
WS 197	56° 00′ 00″ S, 40° 50′ 00″ W	17 iv	0500	2492	ESE	1	ESE	3	o.	1003·9	– 0·3	v. heavy swell
WS 198	57° 30′ 00″ S, 42° 52′ 00″ W	19 iv	1300	3775	E	2	E	2	o. c.	992·7	0·6	slight swell
WS 199	58° 10′ 00″ S, 44° 10′ 00″ W	20 iv	1025	3813 gn. gy. M.	E × N	3	E × N	2	o. c.	991·7	– 1·7	slight swell

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S °/₀₀	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p. l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
WS 196	23	0	2·73	33·63	26·84	—	—	—	N 70 V	50–0	1717			
		5	2·73	33·63	26·84	—	—	—	,,	100–50				
		10	2·73	33·63	26·84	—	—	—	,,	200–100				
		20	2·73	33·63	26·84	—	—	—	N 50 V	100–0	—	1825		
		30	2·73	33·63	26·84	—	—	—	N 100 B	103–0	1921	1941	⅔	KT
		40	2·73	33·64	26·84	—	—	—	N 70 B					
		50	2·73	33·65	26·85									
		60	2·71	33·69	26·88									
		80	1·72	33·81	27·06									
		100	0·83	33·92	27·21									
		150	0·42	34·06	27·34									
		200	0·85	34·17	27·41									
WS 197	27	0	1·35	33·74	27·03	—	—	—	N 50 V	100–0	0530			
		5	1·27	33·74	27·03	—	—	—	N 70 V	50–0				
		10	1·27	33·74	27·03	—	—	—	,,	100–50				
		20	1·22	33·73	27·02	—	—	—	,,	250–100				
		30	1·29	33·74	27·03	—	—	—	,,	500–265				
		40	1·29	33·74	27·03	—	—	—	,,	750–500				
		50	1·29	33·74	27·03	—	—	—	,,	1000–800	—	0915		
		60	1·29	33·75	27·04	—	—	—	N 100 B	113–0	1018	1039	⅔	KT
		80	0·92	33·91	27·19	—	—	—	N 70 B					
		100	0·89	34·04	27·30									
		150	0·28	34·32	27·56									
		200	0·56	34·42	27·62									
		300	1·22	34·59	27·72									
		400	1·33	34·62	27·75									
		1000	1·27	34·65	27·76									
		1500	1·23	34·66	27·77									
WS 198	29	0	1·74	33·87	27·11	—	—	—	N 50 V	100–0	1310			
		5	1·72	33·87	27·11	—	—	—	N 70 V	50–0				
		10	1·72	33·87	27·11	—	—	—	,,	100–50				
		20	1·72	33·87	27·11	—	—	—	,,	250–100				
		30	1·72	33·87	27·11	—	—	—	,,	500–250				
		40	1·72	33·87	27·11	—	—	—	,,	750–500				
		50	1·72	33·87	27·11	—	—	—	,,	1000–740	—	1610		
		60	1·72	33·87	27·11	—	—	—	N 100 B	109–0	1805	1825	⅔	KT
		70	1·49	33·95	27·19	—	—	—	N 70 B					
		80	0·81	33·97	27·25									
		100	0·48	34·05	27·33									
		150	1·63	34·33	27·48									
		200	1·31	34·36	27·53									
		300	1·13	34·48	27·64									
		400	1·76	34·61	27·70									
		500	1·82	34·65	27·72									
		750	1·80	34·70	27·77									
		1000	1·78	34·69	27·76									
		1500	1·51	34·70	27·80									
WS 199	0	0	0·71	34·07	27·34	—	—	—	N 50 V	100–0	1025			
		5	0·69	34·07	27·34	—	—	—	N 70 V	50–0				
		10	0·69	34·07	27·34	—	—	—	,,	100–50				
		20	0·69	34·07	27·34	—	—	—	,,	250–100				
		30	0·69	34·07	27·34	—	—	—	,,	500–250				
		40	0·69	34·07	27·34	—	—	—	,,	750–500				
		50	0·69	34·07	27·34	—	—	—	,,	1000–750	—	1255		
		60	0·69	34·07	27·34	—	—	—	N 100 B	119–0	1430	1450	⅔	KT
		80	0·67	34·22	27·45	—	—	—	N 70 B					
		100	0·79	34·34	27·54									
		150	0·99	34·44	27·62									
		200	1·48	34·59	27·71									

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 199 *cont.*	58° 10′ 00″ S, 44° 10′ 00″ W	1928 20 iv										
WS 200	59° 05′ 00″ S, 46° 32′ 00″ W	21 iv	1215	1317 gn. M.	SW	4	SW	1	o. c.	1007·7	− 1·7	
WS 201	59° 57′ 00″ S, 50° 12′ 00″ W	22 iv	1840	4134	NW	1	NW	1	f.	999·7	− 2·2	
WS 202	60° 23′ 00″ S, 52° 52′ 00″ W	23 iv	1830	3987 gn. M. sm. P.	SW	1	—	0	b.	980·2	− 1·1	station worked in open lane inside pack ice

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p. l.	Gear	Depth (metres)	TIME From	TIME To	Length of tow (miles)	
WS 199 *cont.*		300	1·51	34·62	27·73									
		400	1·52	34·69	27·77									
		500	1·59	34·70	27·78									
		750	1·10	34·69	27·80									
WS 200	1	0	0·47	34·04	27·32	—	—	—	N 50 V	100–0	1220			
		5	0·59	34·01	27·29	—	—	—	N 70 V	50–0				
		10	0·60	34·01	27·29	—	—	—	,,	100–50				
		20	0·64	34·01	27·29	—	—	—	,,	250–100				
		30	0·64	34·01	27·29	—	—	—	,,	500–250				
		40	0·62	34·01	27·29	—	—	—	,,	750–500				
		50	0·52	34·01	27·30	—	—	—	,,	1000–730	—	1420		
		60	0·59	34·01	27·29	—	—	—	N 100 B	93–0	1444	1505	⅔	KT
		80	0·64	34·20	27·44	—	—	—	N 70 B					
		100	0·66	34·30	27·51									
		150	0·99	34·46	27·63									
		200	1·22	34·53	27·67									
		300	1·58	34·64	27·74									
		400	1·59	34·64	27·74									
		500	1·55	34·69	27·77									
		750	1·31	34·68	27·79									
		1000	0·92	34·70	27·83									
WS 201	2	0	−0·65	34·05	27·39	—	—	—	N 50 V	100–0	1847			
		5	−0·62	34·05	27·38	—	—	—	N 70 V	50–0				
		10	−0·63	34·05	27·39	—	—	—	,,	100–50				
		20	−0·62	34·06	27·39	—	—	—	,,	250–100				
		30	−0·61	34·06	27·39	—	—	—	,,	500–250				
		40	−0·61	34·07	27·40	—	—	—	,,	750–500				
		50	−0·61	34·07	27·40	—	—	—	,,	1000–750	—	2255		
		60	−0·61	34·07	27·40	—	—	—	N 100 B	99–0	2322	2344	⅔	KT
		80	−0·53	34·10	27·42	—	—	—	N 70 B					
		100	−0·35	34·18	27·48									
		150	−0·47	34·34	27·62									
		200	−0·56	34·41	27·67									
		300	−0·39	34·56	27·79									
		400	−0·28	34·57	27·79									
		500	−0·19	34·57	27·79									
		750	0·01	34·60	27·80									
		1000	−0·06	34·61	27·82									
		1500	−0·17	34·65	27·85									
WS 202	3	0	−1·68	33·78	27·21	—	—	—	N 50 V	100–0	1845			
		5	−1·68	33·78	27·21	—	—	—	N 70 V	50–0				
		10	−1·69	33·78	27·21	—	—	—	,,	100–50	—	—	—	ship moved to clear pack ice
		20	−1·69	33·78	27·21	—	—	—	,,	250–100				
		30	−1·64	33·79	27·22	—	—	—	,,	500–250	—	2115	—	,, ,,
		40	−1·54	33·83	27·25	—	—	—	,,	750–500	2135	2210	—	ship moved
		50	−1·49	33·87	27·26	—	—	—	,,	1000–750	2240	2315		
		60	−1·37	33·95	27·33	—	—	—	N 100 B	72–0	2335	2352	⅔	KT
		70	−0·86	34·09	27·42	—	—	—	N 70 B					
		80	−0·71	34·14	27·47									
		100	−0·61	34·21	27·51									
		150	−0·47	34·33	27·60									
		200	−0·49	34·33	27·60									
		300	−0·61	34·53	27·78									
		400	−0·51	34·56	27·80									
		500	−0·26	34·61	27·82									
		750	0·02	34·64	27·84									
		1000	0·01	34·65	27·84									
		1500	−0·19	34·65	27·85									

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 203	57° 42′ 00″ S, 53° 12′ 00″ W	1928 25 iv	1845	4259 br. gy. M. St.	S	2	S	1	b.	1002·3	1·7	heavy swell
WS 204	56° 27′ 00″ S, 54° 22′ 00″ W	26 iv	1900	3388 br. gy. M.	S × W	4	—	—	b. c.	1012·6	− 2·2	v. heavy swell
WS 205	55° 49′ 00″ S, 56° 18′ 00″ W	27 iv	1715	4207 y. gy. M.	NW × N	1	—	0	b. c.	1010·3	4·4	
WS 206	54° 43′ 00″ S, 58° 02′ 00″ W	28 iv	0950	389 G.	SW×W	1	SW×W	1	b. c.	1001·3	4·4	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.³	O_2 cc. p.l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
WS 203	6	0	1·72	33·84	27·08	—	—	—	**N 50 V**	100–0	**1915**			
		5	1·74	33·84	27·08	—	—	—	**N 70 V**	500–250	—	**2014**		
		10	1·74	33·84	27·08	—	—	—	,,	750–500	**2112**			
		20	1·74	33·84	27·08	—	—	—	,,	250–100				
		30	1·74	33·84	27·08	—	—	—	,,	100–50				
		40	1·74	33·84	27·08	—	—	—	,,	1000–750				
		50	1·74	33·84	27·08	—	—	—	,,	50–0	—	**2245**		
		60	1·74	33·84	27·08	—	—	—	**N 100 B**	93–0	**2325**	**2346**	⅔	KT
		70	1·10	33·84	27·12	—	—	—	**N 70 B**					
		80	− 0·01	33·93	27·26									
		100	− 0·16	33·95	27·29									
		150	0·74	34·15	27·41									
		200	1·49	34·31	27·48									
		300	1·72	34·44	27·57									
		400	1·79	34·52	27·62									
		500	2·05	34·55	27·64									
		750	2·01	34·63	27·70									
		1000	1·84	34·70	27·77									
WS 204	7	0	3·99	34·11	27·10	—	—	—	**N 50 V**	100–0	**1915**			
		5	4·19	34·13	27·09	—	—	—	**N 70 V**	500–310				
		10	4·14	34·13	27·09	—	—	—	,,	250–100				
		20	4·14	34·13	27·09	—	—	—	,,	100–50				
		30	4·14	34·13	27·09	—	—	—	,,	750–500				
		40	3·59	34·05	27·09	—	—	—	,,	1000–750				
		50	3·72	34·06	27·09	—	—	—	,,	50–0	—	**0135**		
		60	3·68	34·06	27·09	—	—	—	**N 100 B**	91–0	**0158**	**0218**	⅔	KT
		80	3·59	34·05	27·09	—	—	—	**N 70 B**					
		100	3·39	34·02	27·09									
		125	1·02	34·01	27·27									
		150	0·77	34·03	27·28									
		200	0·71	34·06	27·33									
		300	1·79	34·25	27·40									
		400	2·12	34·38	27·49									
		500	2·26	34·45	27·53									
		750	2·24	34·58	27·64									
		1000	2·11	34·66	27·71									
WS 205	8	0	5·43	34·10	26·93	—	—	—	**N 50 V**	100–0	**1723**			
		5	5·57	34·11	26·92	—	—	—	**N 70 V**	50–0				
		10	5·60	34·11	26·92	—	—	—	,,	100–50				
		20	5·62	34·11	26·92	—	—	—	,,	250–100				
		30	5·60	34·11	26·92	—	—	—	,,	500–250				
		40	5·59	34·11	26·92	—	—	—	,,	750–500				
		50	5·59	34·11	26·92	—	—	—	,,	1000–750	—	**1935**		
		60	5·56	34·11	26·92	—	—	—	**N 100 B**	103–0	**2126**	**2146**	⅔	KT
		80	5·49	34·11	26·93	—	—	—	**N 70 B**					
		100	5·44	34·11	26·94									
		150	5·23	34·15	27·00									
		200	4·94	34·17	27·05									
		300	4·59	34·17	27·09									
		400	4·10	34·20	27·16									
		500	3·59	34·16	27·18									
		750	3·25	34·20	27·24									
		1000	2·78	34·39	27·45									
		1500	2·31	34·56	27·61									
WS 206	9	0	5·59	34·10	26·91	—	—	—	**N 50 V**	100–0	1000			
		5	5·81	34·10	26·88	—	—	—	**N 70 V**	50–0				
		10	5·89	34·10	26·87	—	—	—	,,	100–50				
		20	5·91	34·10	26·87	—	—	—	,,	250–100				
		30	5·91	34·10	26·87	—	—	—	,,	350–250	—	1100		

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 206 *cont.*	54° 43′ 00″ S, 58° 20′ 00″ W	1928 28 iv										
WS 207	54° 12′ 00″ S, 58° 40′ 00″ W	28 iv	1415	128 Po. Co.	SW × S	2	SW × S	2	o. c.	997·0	3·9	
WS 208	54° 10′ 00″ S, 59° 38′ 00″ W	28 iv	2015	82 R.	W × N	2	W × N	1	o. c. r.	994·0	4·2	
WS 209	54° 08′ 00″ S, 60° 40′ 00″ W	28–29 iv	0000	100 G.	SW × S	5	SW × S	4	s. c. r.	993·4	3·3	
WS 210	50° 17′ 00″ S, 60° 06′ 00″ W	29 v	0800 1130	161 gn. S. —	SW —	3 —	SW —	3 —	b. c. —	1013·9 1015·5	4·4	
WS 211	50° 17′ 00″ S, 60° 06′ 00″ W	29 v	1155 1430	— 174 gn. S.	SW	3	SW	3	b. c.	1015·5	4·4	
WS 212	49° 22′ 00″ S, 60° 10′ 00″ W	30 v	0800 1230	242 gn. S. M.P. 249 gn. S. M.P.	E	4	E	4	c.	1024·9	3·3	
WS 213	49° 22′ 00″ S, 60° 10′ 00″ W	30 v	1400 1630	249 gn. S. M.P. 239 gn. S. M.P.	SE	3	SE	3	c.	1029·9	3·3	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
WS 206 *cont.*		40	5·89	34·10	26·87	—	—	—	**N 100 B**	70–0	1148	1208	⅔	KT
		50	5·91	34·10	26·87	—	—	—	**N 70 B**					
		60	5·85	34·10	26·88									
		80	5·85	34·14	26·92									
		100	5·83	34·16	26·93									
		150	5·52	34·16	26·97									
		200	5·27	34·20	27·03									
		300	5·06	34·23	27·07									
		350	4·77	34·34	27·20									
WS 207	9	0	6·02	34·07	26·84	—	—	—	**N 50 V**	100–0	1430			
		5	6·02	34·07	26·84	—	—	—	**N 70 V**	50–0				
		10	6·02	34·07	26·84	—	—	—	,,	100–50	—	1500		
		20	6·02	34·07	26·84	—	—	—	**N 100 B**	75–0	1540	1600	⅔	KT
		30	6·02	34·07	26·84	—	—	—	**N 70 B**					
		40	6·02	34·07	26·84									
		50	6·02	34·07	26·84									
		60	6·02	34·07	26·84									
		80	6·02	34·07	26·84									
WS 208	9	0	6·22	34·06	26·80	—	—	—	**N 50 V**	70–0	2025			
		5	6·22	34·06	26·80	—	—	—	**N 70 V**	70–0	—	2044		
		10	6·22	34·06	26·80	—	—	—	**N 100 B**	65–0	2115	2125	⅓	KT
		20	6·22	34·06	26·80	—	—	—	**N 70 B**					
		30	6·22	34·06	26·80									
		40	6·22	34·06	26·80									
		50	6·22	34·06	26·80									
		60	6·22	34·06	26·80									
		70	6·22	34·06	26·80									
WS 209	10	0	6·21	34·06	26·80	—	—	—	**N 50 V**	80–0	0010			
		5	6·21	34·06	26·80	—	—	—	**N 70 V**	80–0	—	0040		
		10	6·23	34·06	26·80	—	—	—	**N 100 B**	36–0	0111	0121	⅓	KT. Heavy rain snow-squalls
		20	6·23	34·06	26·80	—	—	—	**N 70 B**					
		30	6·27	34·07	26·80									
		40	6·27	34·07	26·80									
		50	6·21	34·07	26·81									
		60	6·21	34·07	26·81									
		70	—	34·07										
		80	6·23	34·07	26·81									
WS 210	10	0	6·55	33·88	26·63	—	—	—	**DC**	161	—	0905		
									OTC	161	1015	1040	1⅔	trawl hitched; did not fish properly
									N 7–T					
									N 4–T					
									NCS–T					
WS 211	10	—	—	—	—	—	—	—	**OTC**	161–174	1217	1325	4½	
									N 7–T					
		0	6·59	33·85	26·59	—	—	—	**N 4–T**					
		160	5·58	33·88	26·75	—	—	—	**NCS–T**					
WS 212	11	0	6·50	33·91	26·64	—	—	—	**DC**	242	0830	0850		
		230	5·69	34·03	26·85	—	—	—	**OTC**	242–249	1055	1155	4	trawl hitched; no catch
		0	6·35	33·95	26·69	—	—	—	**N 7–T**					
		230	5·84	34·04	26·83	—	—	—	**N 4–T**					
									NCS–T					
WS 213	11	0	6·35	33·95	26·69	—	—	—	**OTC**	249–239	1430	1545	5	
		230	5·84	34·04	26·83	—	—	—	**N 7–T**					
		0	6·45	33·93	26·66	—	—	—	**N 4–T**					
		225	5·59	34·06	26·88	—	—	—	**NCS–T**					

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 214	48° 25′ 00″ S, 60° 40′ 00″ W	1928 31 v	0630 1100	208 f. d. S. 219 f. d. S.	SE	1	SE	1	b. c.	1028·9	3·9	
WS 215	47° 37′ 00″ S, 60° 50′ 00″ W	31 v	1500 1720	219 f. gn. S. 146 f. gn. S.	SE	1	SE	2	c.	1027·6	4·4	
WS 216	47° 37′ 00″ S, 60° 50′ 00″ W	1 vi	0645 1030	219 f. S. 133 f. S.	E	3	E	3	b. c.	1024·3	3·9	slight E swell
WS 217	46° 28′ 00″ S, 60° 18′ 00″ W	1 vi	1530 1820	146 f. gn. S. 146 f. gn. S.	E	3	E	3	c.	1023·8	3·3	mod. E swell
WS 218	45° 45′ 00″ S, 59° 35′ 00″ W	2 vi	0630 1020	311 d. S. 247 d. S.	E	3	E	3	c.	1018·9	4·2	
WS 219	47° 06′ 00″ S, 62° 12′ 00″ W	3 vi	0630 0955	116 d. S. 114 d. S.	SE	2	SE	2	b. c.	1017·1	3·9	slight E swell
WS 220	47° 56′ 00″ S, 62° 38′ 00″ W	3 vi	1530 1740	108 br. S. 104 br. S.	E	4	E	3	b. c.	1004·8	3·9	
WS 221	48° 23′ 00″ S, 65° 10′ 00″ W	4 vi	0735 1000	76 br. S. M. P.l.St. Sh. 91 br. S. M. P.l.St. Sh.	N	3	N	3	b. c.	1007·7	3·9	mod. N swell
WS 222	48° 23′ 00″ S, 65° 00′ 00″ W	8 vi	0615 0930	100 c. br. S. Sh. 106 c. br. S. Sh.	N × E	4	N × E	4	c.	1009·1	7·5	heavy NE swell
WS 223	49° 13′ 00″ S, 64° 52′ W	8 vi	1445 1715	114 c. br. S. Sh. 114 c. br. S. Sh.	NE	5	NE	4	c.	1002·2	7·2	v. heavy N swell

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S °/₀₀	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME From	TIME To	Length of tow (miles)	
WS 214	12	0	6·67	33·91	26·62	—	—	—	DC	208	**0630**	**0650**		
		200	5·54	33·88	26·76	—	—	—	OTC	208–219	0910	1010	4	trawl torn
		0	6·90	33·89	26·58	—	—	—	N 7–T					
		215	5·71	33·94	26·76	—	—	—	N 4–T					
									NCS–T					
WS 215	12	0	6·67	33·87	26·60	—	—	—	DC	219	1505	1525		
		215	5·89	33·92	26·73	—	—	—	OTC	219–146	1600	**1700**	4	trawl hitched; did not fish
		0	6·63	33·87	26·61	—	—	—	N 7–T					
		130	5·82	33·90	26·73	—	—	—	N 4–T					
									NCS–T					
WS 216	13	0	6·67	33·89	26·61	—	—	—	OTC	219–133	0830	0935	4⅓	
		200	5·79	33·91	26·75	—	—	—	N 7–T					
		0	6·70	33·85	26·58	—	—	—	N 4–T					
		125	6·19	33·89	26·68	—	—	—	NCS–T					
WS 217	13	0	7·03	33·78	26·49	—	—	—	DC	146	1545	1555		
		140	6·39	33·88	26·65	—	—	—	OTC	146–146	**1635**	**1735**	4	
		0	—	33·78	—	—	—	—	N 7–T					
		135	6·34	—	—	—	—	—	N 4–T					
									NCS–T					
WS 218	14	0	6·49	33·90	26·65	—	—	—	DC	311	**0700**	**0715**		
		300	4·99	34·06	26·95	—	—	—	OTC	311–247	0820	0920	4	
		0	6·63	33·90	26·63	—	—	—	N 7–T					
		235	5·79	34·01	26·82	—	—	—	N 4–T					
									NCS–T					
WS 219	15	0	7·60	33·37	26·07	—	—	—	DC	116				
		110	7·56	33·50	26·18	—	—	—	OTC	116–114	0817	0917	4	
		0	7·58	33·34	26·05	—	—	—	N 7–T					
		110	7·60	33·49	26·17	—	—	—	N 4–T					
									NCS–T					
WS 220	15	100	7·83	33·37	26·03	—	—	—	DC	108	1530	1545		
		0	7·55	33·39	26·09	—	—	—	OTC	108–104	1608	**1710**	4	
		100	7·81	33·38	26·05	—	—	—	N 7–T					
									N 4–T					
									NCS–T					
WS 221	16	0	8·15	33·07	25·76	—	—	—	DC	76	0750	0805		
		70	8·22	33·03	25·72	—	—	—	OTC	76–91	0835	0935	4	trawl hitched
									NCS–T					
WS 222	20	0	8·05	33·30	25·94	—	—	—	DC	100	**0625**	**0648**		
		90	8·12	33·29	25·93	—	—	—	OTC	100–106	0755	0857	4	
		0	8·05	33·30	25·94	—	—	—	N 7–T					
		90	7·96	33·29	25·96	—	—	—	N 4–T					
									NCS–T					
WS 223	20	0	7·23	33·45	26·19	—	—	—	DC	114	1449	1501		
		105	7·13	33·45	26·20	—	—	—	OTC	114–114	1541	**1646**	4⅓	
		0	7·30	33·45	26·18	—	—	—	N 7–T					
		105	7·14	33·44	26·19	—	—	—	N 4–T					
									NCS–T					

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 224	50° 18′ 00″ S, 65° 07′ W	1928 9 vi	0530 0905	124 gn. S. 126 gn. S.	N	3	N × E	3	c.	998·2	7·5	mod. N swell
WS 225	50° 20′ 00″ S, 62° 30′ 00″ W	9 vi	2030 2342	162 gn. S. Sh. P. 161 gn. S. Sh. P.	NW	1	NW	2	b. c.	1000·3	7·2	mod. N swell
WS 226	49° 20′ 00″ S, 62° 30′ 00″ W	10 vi	0715 1000	144 gn. S. 152 gn. S.	NE	2	NE	3	c.	997·4	6·4	
WS 227	51° 08′ 00″ S, 56° 50′ 00″ W	12 vi	0515 0940	320 f. gn. S. 298 f. gn. S.	E	3	E	4	c.	—	3·6	
WS 228	50° 50′ 00″ S, 56° 58′ 00″ W	30 vi	0630 1030	229 Sh. c. w. S. 236 Sh. c. w. S.	SW	3	SW	2	c.	1013·3	3·9	
WS 229	50° 35′ 00″ S, 57° 20′ 00″ W	1 vii	0855 1250	210 f. gn. S. 271 f. gn. S.	NW	3	NW	2	c.	1013·3	4·7	
WS 230	50° 10′ 00″ S, 58° 42′ 00″ W	3 vii	1230 1615	169 f. gn. S. 167 f. gn. S.	NW	3	NW	3	c.	989·6	6·1	mod. NW swell
WS 231	50° 10′ 00″ S, 58° 42′ 00″ W	4 vii	0740 1030	167 f. gn. S. 159 f. gn. S.	NW	5	NW	4	b. c.	993·4	7·0	
WS 232	49° 25′ 00″ S, 59° 45′ 00″ W	5 vii	0640 0930	198 f. gn. S. 190 f. gn. S.	N × E	2	N × E	3	b. c.	996·5	6·5	mod. N×E swell
WS 233	49° 25′ 00″ S, 59° 45′ 00″ W	5 vii	1120 1313	185 f. gn. S. 175 f. gn. S.	NW	3	NW	3	c.	998·0	7·2	
WS 234	48° 52′ 00″ S, 60° 25′ 00″ W	5 vii	1645 1930	195 f. gn. S. 207 f. gn. S.	W × N	3	W × N	3	c.	996·1	6·7	mod. NW swell
WS 235	47° 56′ 00″ S, 61° 10′ 00″ W	6 vii	0630 0920	155 d. gn. S. 155 d. gn. S.	NE	1	NE – N	2	c.	1002·0	6·7	sea conf.

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
WS 224	21	0	7·35	33·49	26·20	—	—	—	**DC**	124	**0630**	**0648**		
		120	7·41	33·45	26·16	—	—	—	**OTC**	124–126	0720	0837	5	
		0	7·35	33·49	26·20	—	—	—	**N 7–T**					
		120	7·31	33·45	26·18	—	—	—	**NCS–T**					
WS 225	21	0	6·85	33·71	26·45	—	—	—	**DC**	162	**2039**	**2104**		
		155	6·84	33·95	26·63	—	—	—	**OTC**	162–161	**2150**	**2256**	4⅓	
		0	6·85	33·70	26·44	—	—	—	**N 7–T**					
		155	6·81	33·82	26·54	—	—	—	**NCS–T**					
WS 226	22	0	6·86	33·74	26·47	—	—	—	**DC**	144	**0720**	**0747**		
		140	6·91	33·74	26·46	—	—	—	**OTC**	144–152	0820	0921	4	trawl clear; did not fish on bottom continuously?
		0	6·85	—	—	—	—	—	**N 7–T**					
		145	6·89	33·72	26·45	—	—	—	**NCS–T**					
WS 227	24	0	5·78	33·87	26·72	—	—	—	**DC**	320	**0615**	**0655**		
		315	4·56	34·13	27·05	—	—	—	**OTC**	320–298	**0754**	0859	4⅓	trawl clear; did not fish on bottom continuously?
		0	5·75	33·88	26·73	—	—	—	**N 7–T**					
		290	4·93	34·11	27·00	—	—	—	**NCS–T**					
WS 228	13	0	5·34	33·95	26·82	—	—	—	**DC**	229	**0710**			
		220	5·14	34·12	26·98	—	—	—	**OTC**	229–236	0828	0928	4	trawl hitched and badly torn
		0	5·37	33·94	26·81	—	—	—	**N 4–T**					
		230	5·31	34·12	26·96	—	—	—	**NCS–T**					
WS 229	14	0	5·39	33·91	26·78	—	—	—	**DC**	210	**0800**	1018		
		200	5·31	34·10	26·94	—	—	—	**OTC**	210–271	1100	1202	4	catch of trawl negligible; left bottom with change of depth?
		0	5·46	33·87	26·75	—	—	—	**N 7–T**					
		260	5·01	34·16	27·03	—	—	—	**N 4–T**					
									NCS–T					
WS 230	15	0	5·75	33·93	26·75	—	—	—	**DC**	169	1235	1312		
		160	5·71	33·97	26·79	—	—	—	**OTC**	169–167	1350	1450	4	trawl badly hitched
		0	5·78	33·99	26·81	—	—	—	**N 7–T**					
		160	5·71	33·98	26·80	—	—	—	**N 4–T**					
									NCS–T					
WS 231	16	0	5·95	33·91	26·72	—	—	—	**OTC**	167–159	0826	0931	4⅓	trawl appeared to have fished properly
		160	5·81	33·96	26·77	—	—	—	**N 7–T**					
		0	5·95	33·96	26·76	—	—	—	**N 4–T**					
		150	5·85	33·94	26·75	—	—	—	**NCS–T**					
WS 232	17	0	5·88	33·99	26·79	—	—	—	**DC**	198	**0645**	**0707**		
		190	5·65	34·10	26·90	—	—	—	**OTC**	198–190	**0755**	**0855**	4	trawl badly hitched; no catch
		0	5·88	33·97	26·77	—	—	—	**N 7–T**					
		185	5·61	34·10	26·91	—	—	—	**N 4–T**					
									NCS–T					
WS 233	17	0	5·88	33·90	26·72	—	—	—	**OTC**	185–175	1134	1234	4	
		185	5·61	34·06	26·88	—	—	—	**N 7–T**					
		0	5·79	33·96	26·78	—	—	—	**N 4–T**					
		170	5·63	34·07	26·88	—	—	—	**NCS–T**					
WS 234	17	0	5·94	—	—	—	—	—	**DC**	195	**1650**			
		190	5·66	—	—	—	—	—	**OTC**	195–207	**1750**	**1850**	4	
		0	5·91	33·92	26·73	—	—	—	**N 7–T**					
		200	5·54	34·10	26·92	—	—	—	**N 4–T**					
									NCS–T					
WS 235	18	0	6·23	33·86	26·64	—	—	—	**DC**	155	**0635**	**0711**		
		150	5·60	34·05	26·87	—	—	—	**OTC**	155–155	0755	0855	4	
		0	6·11	33·87	26·68	—	—	—	**N 7–T**					
		150	5·64	34·06	26·87	—	—	—	**N 4–T**					
									NCS–T					

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 236	46° 55′ 00″ S, 60° 40′ 00″ W	1928 6 vii	1500	272 d. gn. S. M.	N	3	N	2	c.	994·4	8·3	
			1755	300 d. gn. S. M.								
WS 237	46° 00′ 00″ S, 60° 05′ 00″ W	7 vii	0950	150 c. br. S. Sh.	N	4	N	4	b. c.	998·1	8·2	heavy N swell
			1235	256 c. br. S. Sh.								
WS 238	48° 30′ 00″ S, 61° 50′ 00″ W	8 vii	0820	148 c. br. S. P. St. b. Cy.	NE	3	NE	2	c.	1003·5	5·0	slight NE swell
			1100	148 c. br. S. P. St. b. Cy.								
WS 239	51° 10′ 00″ S, 62° 10′ 00″ W	15 vii	1600	196 c. d. S.	W	2	W	1	b. c.	985·9	6·7	slight NW swell
			1900	193 c. d. S.								
WS 240	51° 55′ 00″ S, 65° 10′ 00″ W	16 vii	0845	144 c. br. S.	S	7–8	S	3	c.	990·7	1·7	heavy WSW swell
			1100	141 c. br. S.								
WS 241	51° 55′ 00″ S, 65° 10′ 00″ W	16 vii	1505	143 c. br. S.	WSW	5	WSW	4	b. c.	995·8	– 0·6	heavy SW swell
			1700	157 c. br. S.								
WS 242	51° 06′ 00″ S, 66° 30′ 00″ W	17 vii	0610	119 c. d. S. P.	WSW	3	WSW	3	c.	1001·0	3·1	slight W swell
			0914	119 c. d. S. P.								
WS 243	51° 06′ 00″ S, 64° 30′ 00″ W	17 vii	1530	144 c. d. S.	WSW	2	WSW	2	b. c.	1002·7	1·7	
			1740	141 c. d. S.								
WS 244	52° 00′ 00″ S, 62° 40′ 00″ W	18 vii	0645	253 f. d. S. M.	W	2	W	2	b. c.	1006·5	3·9	slight W swell
			0945	247 f. d. S. M.								
WS 245	52° 36′ 00″ S, 63° 40′ 00″ W	18 vii	1535	304 d. gn. S. Md. s. P. Sh.	SW	3	SW	2	b. c.	1010·7	3·9	
			1900	290 d. gn. S. Md. s. P. Sh.								
WS 246	52° 25′ 00″ S, 61° 00′ 00″ W	19 vii	0855	267 c. gn. S. P.	SSW	3	SSW	3	b. c. s. q.	1018·4	3·1	mod. W swell
			1200	208 c. gn. S. P.								
			1250	192 c. gn. S. Sh. St. Po.								

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
WS 236	18	0	6·09	33·99	26·77	—	—	—	**DC**	272	1508	1531		
		265	6·01	—	—	—	—	—	**OTC**	272–300	1608	**1708**	4	bottle touched bottom
		0	6·07	33·94	26·72	—	—	—	**N 7–T**					
		295	4·91	34·15	27·04	—	—	—	**N 4–T**					
									NCS–T					
WS 237	19	0	6·19	33·90	26·69	—	—	—	**DC**	150	0955	1019	—	soundings changed abruptly 10 minutes before end of trawl
		145	5·29	34·10	26·95	—	—	—	**OTC**	150–256	1055	1155	4	
		0	6·13	33·90	26·69	—	—	—	**N 7–T**					
		250	5·51	34·07	26·90	—	—	—	**N 4–T**					
									NCS–T					
WS 238	20	0	6·41	33·74	26·53	—	—	—	**DC**	148	0830	0855		
		140	6·41	33·77	26·55	—	—	—	**OTC**	148–148	0932	1032	4	
									N 7–T					trawl torn away from foot-rope; no catch in it or in fine nets
									N 4–T					
									NCS–T					
WS 239	28	0	5·91	33·74	26·59	—	—	—	**DC**	196	1613	**1634**		
		190	5·68	33·90	26·75	—	—	—	**OTC**	196–193	**1708**	**1811**	4	
		0	5·90	33·72	26·58	—	—	—	**N 7–T**					
		175	5·93	34·00	26·79	—	—	—	**N 4–T**					
									NCS–T					
WS 240	29	0	5·60	33·61	26·53	—	—	—	**DC**	144	0853	0910		
		140	5·61	33·62	26·54	—	—	—	**OTC**	144–141	0942	1044	4	
		0	5·61	33·60	26·52	—	—	—	**N 7–T**					trawl badly hitched; no catch. NCS–T torn away
		135	5·64	33·62	26·53	—	—	—	**N 4–T**					
									NCS–T					
WS 241	29	—	—	—	—	—	—	—	**OTC**	143–157	1522	**1624**	4	
									N 7–T					trawl had not fished on bottom; empty
									N 4–T					
WS 242	0	0	6·23	33·13	26·07	—	—	—	**DC**	119	**0625**	**0650**		
		110	6·24	33·18	26·11	—	—	—	**OTC**	119–119	**0740**	0841	4	
		0	6·27	33·13	26·06	—	—	—	**N 7–T**					
		110	6·29	33·14	26·07	—	—	—	**N 4–T**					
WS 243	0	0	5·91	33·31	26·25	—	—	—	**DC**	144	1535	1550		
		140	5·91	33·32	26·26	—	—	—	**OTC**	144–141	1616	**1716**	4	
		0	5·94	33·33	26·26	—	—	—	**N 7–T**					
		135	6·03	33·43	26·34	—	—	—	**N 4–T**					
WS 244	1	0	5·67	33·70	26·59	—	—	—	**DC**	253	**0648**	**0733**		
		245	5·31	34·01	26·87	—	—	—	**OTC**	253–247	0813	0913	4	
		0	5·61	33·73	26·62	—	—	—	**N 7–T**					
		240	5·34	34·02	26·88	—	—	—	**N 4–T**					
WS 245	1	0	5·91	33·58	26·47	—	—	—	**DC**	304	1540	**1630**		
		285	5·27	34·05	26·91	—	—	—	**OTC**	304–290	**1705**	**1810**	4⅓	
		0	5·76	33·67	26·55	—	—	—	**N 7–T**					
		285	5·24	34·06	26·92	—	—	—	**N 4–T**					
WS 246	2	0	5·24	33·78	26·71	—	—	—	**DC**	267	0900	0930		
		260	5·53	33·96	26·81	—	—	—	**OTC**	267–208	1015	1115	4	
		0	5·24	33·83	26·75	—	—	—	**N 7–T**					
		200	5·41	33·92	26·79	—	—	—	**N 4–T**					
									DC	192	1253	1330		

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 247	52° 40′ 00″ S, 60° 05′ 00″ W	1928 19 vii	1840	172 R.	S	2	S	2	b. c.	1023·3	2·2	
WS 248	52° 40′ 00″ S, 58° 30′ 00″ W	20 vii	0700	210 f. gn. S. P. Sh.	S	2	S	1	c.	1026·9	2·8	
			0920	242 f. gn. S. P. Sh.								
WS 249	52° 10′ 00″ S, 57° 30′ 00″ W	20 vii	1400	166 f. br. gn. S. Sh. St.	S	2	S	1	c.	1030·1	3·3	
WS 250	51° 45′ 00″ S, 57° 00′ 00″ W	20 vii	1750	251 f. gn. S.	W	2	W	2	b. c.	1028·0	2·8	
			2115	313 f. gn. S.								
WS 251	52° 02′ 00″ S, 55° 05′ 00″ W	19–20 viii	2300	1578	NW	3	NW	3	b.	1003·9	5·0	
WS 252	52° 20′ 00″ S, 52° 22′ 00″ W	20 viii	1700	2962	NW	5	NW	4	o.	996·9	5·0	
WS 253	52° 40′ 00″ S, 49° 40′ 00″ W	21 viii	1300	3895	WSW	4	WSW	4	c.	1006·2	4·7	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
WS 247	2	—	—	—	—	—	—	—	**DLH**	172	—	—	¼	
WS 248	3	0	5·13	33·88	26·80	—	—	—	**DC**	210				
		200	5·21	33·99	26·87	—	—	—	**OTC**	210–242	**0750**	0850	4	
		0	5·19	33·88	26·80	—	—	—	**N 7–T**					
		235	5·28	33·98	26·86	—	—	—	**N 4–T**					
WS 249	3	0	5·21	33·93	26·81	—	—	—	**DLH**	166	—	—	¼	
		160	5·28	33·97	26·85	—	—	—	**DC**	166	1445	1507		
WS 250	3	0	5·09	34·01	26·90	—	—	—	**DC**	251	**1755**	**1850**		
		245	4·61	34·21	27·11	—	—	—	**OTC**	251–313	**1944**	**2047**	4	
		0	5·11	34·01	26·90	—	—	—	**N 7–T**					
		305	4·17	34·20	27·15	—	—	—	**N 4–T**					
WS 251	4–5	0	4·50	34·17	27·09	7·92	118	—	**N 50 V**	100–0	**2325**	—	—	A 18 ix 28
		5	4·50	34·18	27·10	8·06	134	—	**N 70 V**	50–0				
		10	4·49	34·18	27·11	8·01	122	—	”	100–50				
		20	4·49	34·18	27·11	8·01	133	—	”	250–100				
		30	4·48	34·18	27·11	8·02	122	—	”	500–250				
		40	4·48	34·18	27·11	8·09	129	—	”	750–500				
		50	4·48	34·18	27·11	7·91	112	—	”	1000–750	—	**0221**		
		60	4·48	34·18	27·11	8·02	129	—	**N 100 B**	95–0	**0439**	**0500**	⅔	KT
		70	4·48	34·18	27·11	7·99	124	—	**N 70 B**					
		80	4·48	34·18	27·11	7·90	136							
		100	4·47	34·18	27·11	8·01	140							
		150	4·44	34·18	27·11	8·07	136							
		200	4·41	34·19	27·12	8·10	102							
		300	4·31	34·18	27·13	7·95	93							
		400	4·07	34·16	27·13	7·94	101							
		500	3·82	34·21	27·20	8·14	115							
		750	3·09	34·18	27·25	8·00	137							
WS 252	5	0	3·55	34·13	27·15	8·02	127	—	**N 70 V**	50–0	1700	—	—	A 21 ix 28
		5	3·48	34·13	27·16	8·04	127	—	”	100–50				
		10	3·68	34·14	27·16	7·99	133	—	”	250–100				
		20	3·64	34·16	27·18	7·99	127	—	”	500–250				
		30	3·63	34·15	27·18	7·92	121	—	”	750–480				
		40	3·61	34·15	27·18	8·01	125	—	”	1000–750				
		50	3·56	34·15	27·18	7·96	116	—	**N 50 V**	100–0	—	**1945**		
		60	3·24	34·12	27·19	7·95	122	—	**N 100 B**	146–0	**2143**	**2204**	⅔	KT
		70	3·21	34·12	27·19	7·96	129	—	**N 70 B**					
		80	3·20	34·12	27·19	8·00	132							
		150	2·98	34·12	27·21	7·96	144							
		200	2·91	34·12	27·22	8·01	150							
		300	2·79	34·15	27·26	7·90	166							
		400	2·61	34·19	27·30	7·90	182							
		500	2·47	34·20	27·31	7·90	202							
		750	2·23	34·22	27·34	7·89	188							
		1000	2·39	34·43	27·51	7·85	190							
WS 253	6	0	3·71	34·13	27·14	8·02	119	—	**N 50 V**	100–0	1300	—	—	A 24 ix 28
		5	3·71	34·13	27·14	8·01	123	—	**N 70 V**	50–0				
		10	3·71	34·13	27·14	8·02	121	—	”	100–50				
		20	3·71	34·14	27·15	7·98	116	—	”	250–100				
		30	3·69	34·14	27·16	8·02	129	—	”	500–230				
		40	3·68	34·14	27·16	8·01	136	—	”	750–670				
		50	3·65	34·15	27·17	8·01	143	—	”	1000–670	—	**1855**		
		60	3·63	34·16	27·18	8·02	137	—	**N 100 B**	102–0	**1914**	**1935**	⅔	KT

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 253 *cont.*	52° 40′ 00″ S, 49° 40′ 00″ W	1928 21 viii										
WS 254	53° 03′ 00″ S, 46° 58′ 00″ W	22 viii	1010	3557	W × N	3	W × N	3	b. c.	1011·8	2·8	
WS 255	53° 23′ 00″ S, 44° 10′ 00″ W	22–23 viii	2325	3003 gy. M.	W	2	W	2	o. c.	1008·9	1·7	
WS 256	53° 42′ 00″ S, 40° 33′ 00″ W	23–24 viii	2130	4110	WNW	2	WNW	2	o. m.	1006·4	– 0·6	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME From	TIME To	Length of tow (miles)	
WS 253 *cont.*		80	3·61	34·16	27·18	8·00	140	—	**N 70 B**	102–0	**1914**	**1935**	⅔	KT
		100	3·58	34·16	27·18	7·96	130							
		150	3·56	34·16	27·18	7·90	127							
		200	3·38	34·14	27·19	7·92	130							
		300	2·97	34·13	27·21	7·91	143							
		400	2·76	34·12	27·23	7·91	139							
		500	2·86	34·14	27·24	7·92	135							
		750	2·49	34·14	27·27	7·93	150							
		1000	2·57	34·35	27·42	7·85	155							
WS 254	7	0	0·30	33·92	27·24	7·84	145	—	**N 50 V**	100–0	1015	—	—	A 27 ix 28
		5	0·30	33·92	27·24	7·85	144	—	**N 70 V**	100–50				
		10	0·28	33·92	27·24	7·97	138	—	,,	250–100				
		20	0·27	33·92	27·24	—	143	—	,,	500–250				
		30	0·24	33·92	27·25	7·91	149	—	,,	750–500				
		40	0·26	33·94	27·25	7·90	149	—	,,	1000–750				
		50	0·24	33·94	27·26	7·90	153	—	,,	50–0	—	1230		
		60	0·23	33·94	27·26	7·90	156	—	**N 100 B**	91–0	1339	1400	⅔	KT
		80	0·22	33·94	27·26	7·93	151	—	**N 70 B**					
		100	0·19	33·94	27·26	7·90	144							
		150	0·23	33·96	27·28	7·93	165							
		200	0·22	34·02	27·33	7·87	167							
		300	1·60	34·25	27·42	7·84	190							
		400	1·99	34·31	27·44	7·79	190							
		500	2·11	34·37	27·48	7·94	167							
		750	2·09	34·54	27·62	7·90	137							
		1000	2·01	34·56	27·64	7·91	160							
WS 255	7–8	0	0·32	33·89	27·21	7·97	135	—	**N 70 V**	50–0	**2335**	—	—	A 28 ix 28
		5	0·38	33·89	27·21	8·05	133	—	,,	100–50				
		10	0·35	33·89	27·21	8·06	133	—	,,	250–100				
		20	0·35	33·91	27·23	8·05	134	—	,,	500–270				
		30	0·34	33·92	27·24	7·97	135	—	,,	750–480				
		40	0·34	33·92	27·24	8·00	136	—	,,	1000–700				
		50	0·34	33·92	27·24	8·04	134	—	**N 50 V**	100–0	—	**0310**		
		60	0·34	33·92	27·24	8·00	141	—	**N 100 B**	96–0	**0329**	**0350**	⅔	KT
		80	0·33	33·92	27·24	8·01	138	—	**N 70 B**					
		100	0·32	33·92	27·24	8·00	139							
		150	0·48	33·94	27·24	7·91	141							
		200	1·21	34·09	27·32	7·84	159							
		300	1·76	34·30	27·45	7·84	159							
		400	2·01	34·40	27·51	7·85	162							
		500	2·05	34·43	27·54	7·90	168							
		750	2·07	34·52	27·60	7·86	160							
		1000	1·96	34·60	27·67	7·87	159							
WS 256	8–9	0	– 1·09	33·83	27·23	7·94	156	—	**N 50 V**	100–0	**2140**	—	—	A 29 ix 28
		5	– 1·08	33·83	27·23	7·97	153	—	**N 70 V**	50–0				
		10	– 1·08	33·83	27·23	7·95	153	—	,,	100–50				
		20	– 1·08	33·83	27·23	7·91	149	—	,,	250–100				
		30	– 1·08	33·83	27·23	7·98	152	—	,,	500–250				
		40	– 1·08	33·83	27·23	7·94	155	—	,,	750–500				
		50	– 1·08	33·83	27·23	—	155	—	,,	1000–780	—	**0110**		
		60	– 1·11	33·83	27·23	7·90	155	—	**N 100 B**	100–0	**0150**	**0211**	⅔	KT
		80	– 1·11	33·83	27·23	7·89	155	—	**N 70 B**					
		100	– 0·89	33·91	27·29	7·87	151							
		150	0·59	34·17	27·42	7·78	153							
		200	1·49	34·29	27·46	7·79	185							
		300	1·84	34·49	27·59	7·80	193							
		400	1·89	34·51	27·61	7·70	198							
		500	1·90	34·55	27·65	7·86	189							
		750	1·78	34·61	27·71	7·87	189							

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 257	54° 04′ 00″ S, 36° 18′ 00″ W	1928 27 viii	1600	188	NW	6–7	NW	3–4	b. c.	1003·5	0·0	
WS 258	53° 56′ 00″ S, 36° 06′ 00″ W	27 viii	1915	157	NW	5	NW	5	b. c.	1002·1	− 0·6	
WS 259	53° 49′ 00″ S, 35° 53′ 30″ W	27–28 viii	2305	549	WNW	3	WNW	2	c.	1000·8	− 0·6	
WS 260	53° 42′ 00″ S, 35° 41′ 00″ W	28 viii	0503	—	E	1	W	1	b.	999·8	− 0·6	
WS 261	53° 34′ 30″ S, 35° 28′ 30″ W	28 viii	0650	3798	ESE	1	ESE	1	c.	1002·6	− 1·1	
WS 262	53° 27′ 00″ S, 35° 17′ 00″ W	28 viii	1150	—	E	1	E	1	o.	1004·9	− 1·7	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.³	O_2 cc. p.l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
WS 257	12	0	− 0·91	33·85	27·24	7·95	143	—	**N 70 V**	50–0	1610	—	—	A 1 x 28
		5	− 0·91	33·85	27·24	7·97	142	7·78	,,	100–50	—	—	—	much stray on wires
		10	− 0·91	33·85	27·24	7·94	146	—	,,	150–110				
		20	− 0·91	33·85	27·24	7·96	146	7·78	**N 50 V**	100–0	—	1658		
		30	− 0·91	33·85	27·24	7·90	146	—	**N 100 B**	84–0	1728	1748	⅔	KT
		40	− 0·91	33·87	27·26	7·91	140	7·76	**N 70 B**					
		50	− 0·97	33·95	27·32	7·92	133							
		60	− 0·98	33·95	27·32	7·92	141	7·75						
		80	− 0·94	33·95	27·32	7·92	138							
		100	− 0·91	33·95	27·32	7·92	139	7·73						
		150	− 0·59	33·96	27·31	7·93	140							
WS 258	12	0	− 0·86	33·96	27·32	7·93	135	—	**N 70 V**	50–0	1935	—	—	A 2 x 28
		5	− 0·86	33·96	27·32	7·92	135	7·94	,,	100–50	—	—	—	much stray on wires
		10	− 0·84	33·96	27·32	7·92	153	—	,,	150–110				
		20	− 0·84	33·96	27·32	7·91	153	7·84	**N 50 V**	100–0	—	2025		
		30	− 0·84	33·96	27·32	7·88	153	—	**N 100 B**	91–0	2055	2118	⅔	KT
		40	− 0·84	33·96	27·32	7·92	153	7·80	**N 70 B**					
		50	− 0·84	33·96	27·32	7·93	153							
		60	− 0·84	33·97	27·33	7·92	153	7·82						
		80	− 0·79	34·00	27·35	7·91	153							
		100	− 0·58	34·01	27·35	7·89	160	7·79						
		140	− 0·04	34·04	27·35	7·90	151	6·84						
WS 259	12–13	0	− 1·16	33·94	27·31	7·92	159	—	**N 70 V**	50–0	2315	—	—	A 2 x 28
		5	− 1·01	33·94	27·31	7·92	159	7·79	,,	100–50				
		10	− 1·01	33·94	27·31	7·92	159	—	,,	250–100				
		20	− 1·01	33·96	27·33	7·93	170	8·03	,,	500–250				
		30	− 1·01	33·96	27·33	7·94	174	—	**N 50 V**	100–0	—	0130		
		40	− 1·01	33·96	27·33	7·93	180	7·84	**N 100 B**	103–0	0332	0353	⅔	KT
		50	− 1·01	33·96	27·33	7·86	162	—	**N 70 B**					
		60	− 0·99	33·96	27·33	7·92	167	7·88						
		80	− 1·05	33·97	27·34	7·93	170							
		100	− 1·11	33·97	27·34	7·87	127	7·84						
		150	− 0·78	33·98	27·34	7·95	138	7·63						
		200	0·80	34·16	27·40	7·85	148	5·98						
		300	1·43	34·34	27·51	7·75	135	5·19						
		400	1·98	34·48	27·58	7·80	162	4·41						
		500	2·00	34·53	27·62	7·80	162	4·11						
WS 260	13	—	—	—	—	—	—	—	**N 100 B**	86–0	0515	0535	⅔	KT
									N 70 B					
WS 261	13	0	− 1·75	33·86	27·26	7·91	138	—	**N 70 V**	50–0	0700	—	—	A 2 x 28
		5	− 1·75	33·86	27·26	7·93	132	7·95	,,	100–50				
		10	− 1·75	33·86	27·26	7·90	134	—	,,	250–100				
		20	− 1·75	33·86	27·26	7·92	148	7·89	,,	500–250				
		30	− 1·75	33·86	27·26	8·00	148	—	,,	750–520				
		40	− 1·75	33·86	27·26	7·91	148	8·01	,,	1000–750				
		50	− 1·74	33·86	27·26	7·90	155	—	**N 50 V**	100–0	—	1015		
		60	− 1·74	33·92	27·32	7·91	148	7·87	**N 100 B**	104–0	1031	1051	⅔	KT
		80	− 1·75	33·92	27·32	7·88	148	—	**N 70 B**					
		100	− 1·60	33·92	27·32	7·90	148	7·60						
		150	0·08	34·08	27·39	7·85	169	6·31						
		200	1·08	34·23	27·43	7·83	179	5·41						
		300	1·61	34·36	27·51	7·83	163	4·63						
		400	1·81	34·45	27·56	7·83	157	4·23						
		500	1·91	34·64	27·72	7·84	149	4·22						
		750	1·74	34·62	27·72	7·90	142	4·23						
		1000	1·54	34·70	27·78	7·94	148	4·36						
WS 262	13	—	—	—	—	—	—	—	**N 100 B**	85–0	1200	1223	⅔	KT
									N 70 B					

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 263	53° 20′ 00″ S, 35° 04′ 00″ W	1928 28 viii	1320	3511	E	1	E	1	c.	1006·4	− 2·0	
WS 264	53° 13′ 30″ S, 34° 51′ 00″ W	28 viii	1840	—	W	5	W	3	b. c.	1005·6	− 1·7	
WS 265	52° 40′ 00″ S, 37° 05′ 00″ W	29 viii	1215	—	WNW	4	WNW	4	o. c.	1004·4	0·6	
WS 266	52° 50′ 00″ S, 37° 05′ 00″ W	29 viii	1415	2215	WNW	4	WNW	3	o. c.	1012·9	0·6	
WS 267	53° 01′ 00″ S, 37° 05′ 00″ W	29 viii	1830	—	W	2	W	1	o.	1014·0	0·3	
WS 268	53° 11′ 00″ S, 37° 05′ 00″ W	29 viii	2015	3164	W	2	W	1	o.	1014·0	0·3	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
WS 263	13	0	– 1·65	33·87	27·27	7·94	136	—	**N 50 V**	100–0	1320	—	—	A 3 x 28
		5	– 1·65	33·87	27·28	7·91	132	7·96	**N 70 V**	50–0				
		10	– 1·70	33·87	27·28	7·94	133	—	,,	100–50				
		20	– 1·70	33·87	27·28	7·91	130	8·02	,,	250–100				
		30	– 1·70	33·87	27·28	7·90	163	—	,,	500–0				
		40	– 1·70	33·87	27·28	7·91	162	7·94	,,	500–250				
		50	– 1·70	33·87	27·28	7·92	160	—	,,	750–500				
		60	– 1·70	33·87	27·28	7·82	145	7·96	,,	1000–750	—	1630		
		80	– 1·69	33·87	27·28	7·88	169	—	**N 100 B**	87–0	1710	**1730**	⅔	KT
		100	– 1·49	33·91	27·30	—	—	7·48	**N 70 B**					
		150	0·70	34·15	27·41	7·86	187	5·81						
		200	1·60	34·35	27·51	7·79	189	4·56						
		300	1·90	34·50	27·60	7·68	189	4·11						
		400	1·70	34·58	27·68	7·71	183	4·14						
		500	1·78	34·61	27·70	7·83	136	4·12						
		750	1·68	34·62	27·72	7·84	144	4·21						
		1000	1·50	34·69	27·77	7·88	127	4·32						
WS 264	13	—	—	—	—	—	—	—	**N 100 B**	97–0	**1848**	**1908**	⅔	KT
									N 70 B					
WS 265	14	—	—	—	—	—	—	—	**N 100 B**	130–0	1230	1250	⅔	KT
									N 70 B					
WS 266	14	0	– 0·78	33·89	27·26	7·81	117	—	**N 70 V**	50–0	1420	—	—	A 3 x 28
		5	– 0·80	33·89	27·26	7·89	150	7·69	,,	100–50				
		10	– 0·80	33·89	27·26	7·85	137	—	,,	250–100				
		20	– 0·80	33·89	27·26	7·90	145	7·68	,,	500–250				
		30	– 0·80	33·89	27·26	7·89	155	—	,,	750–500				
		40	– 0·80	33·89	27·26	7·87	160	7·67	,,	1000–760				
		50	– 0·80	33·89	27·26	7·88	160	—	**N 50 V**	100–0	—	1640		
		60	– 0·82	33·91	27·28	7·89	160	7·70	**N 70 B**	89–0	1713	**1733**	⅔	KT
		80	– 0·82	33·91	27·28	7·90	159	—	**N 100 B**					
		100	– 0·82	33·91	27·28	7·90	159	7·70						
		150	0·26	34·05	27·34	7·82	139	7·62						
		200	1·89	34·24	27·40	7·79	142	6·38						
		300	1·94	34·44	27·55	7·78	149	5·12						
		400	2·01	34·50	27·59	7·77	158	4·40						
		500	2·05	34·53	27·62	7·85	144	4·06						
		750	1·95	34·66	27·72	7·85	144	4·02						
		1000	1·75	34·68	27·76	7·82	144	4·18						
WS 267	14	—	—	—	—	—	—	—	**N 70 B**	79–0	**1845**	**1907**	⅔	KT
									N 100 B					
WS 268	14	0	– 1·40	33·89	27·28	7·89	125	—	**N 50 V**	100–0	**2020**	—	—	A 4 x 28
		5	– 1·40	33·89	27·28	7·89	136	—	**N 70 V**	50–0				
		10	– 1·06	33·90	27·28	7·90	118	—	,,	100–50				
		20	– 1·06	33·90	27·28	7·91	116	—	,,	250–100				
		30	– 1·06	33·90	27·28	7·92	126	—	,,	500–250				
		40	– 1·06	33·90	27·28	7·85	122	—	,,	750–100				
		50	– 1·06	33·90	27·28	7·86	125	—	,,	750–500				
		60	– 1·06	33·90	27·28	7·86	121	—	,,	1000–750	—	**2300**		
		80	– 1·08	33·90	27·28	7·87	121	—	**N 70 B**	106–0	**2321**	**2341**	⅔	KT
		100	– 1·08	33·92	27·30	7·88	121	—	**N 100 B**					
		150	– 0·15	34·05	27·37	7·86	128							
		200	1·10	34·24	27·45	7·80	155							
		300	1·71	34·46	27·58	7·70	155							
		400	1·89	34·52	27·62	7·75	156							
		500	1·96	34·55	27·64	7·75	165							
		750	1·93	34·66	27·72	7·82	163							
		1000	1·74	34·70	27·77	7·79	152							

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 269	53° 21′ 00″ S, 37° 05′ 00″ W	1928 30 viii	0050	—	—	0	—	0	o.	1015·8	0·0	
WS 270	53° 31′ 00″ S, 37° 05′ 00″ W	30 viii	0230	932	N	3	N	3	o. c.	1012·8	0·3	
WS 271	53° 42′ 00″ S, 37° 05′ 00″ W	30 viii	0710	—	N × E	3–4	N	3	o. c.	1010·6	0·0	
WS 272	53° 52′ 00″ S, 37° 05′ 00″ W	30 viii	0900	145	NE × N	7–8	NE × N	5	o. c.	1009·4	0·3	
WS 273	53° 24′ 00″ S, 39° 00′ 00″ W	4 ix	0615	—	NW	2	NW	1	o.	1005·3	0·6	mod. NW swell
WS 274	53° 30′ 00″ S, 38° 47′ 00″ W	4 ix	0805	3590	NW	2	NW	4	o. c. f.	1003·5	1·1	fairly heavy swell increasing
WS 275	53° 38′ 00″ S, 38° 34′ 00″ W	4 ix	1300	2231	NW	3	NW	2	o. f. 5	1001·7	0·3	ship rolling heavily

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.³	O_2 cc. p.l.	Gear	Depth (metres)	TIME From	TIME To	Length of tow (miles)	
WS 269	15	—	—	—	—	—	—	—	**N 100 B** **N 70 B**	100–0	**0100**	**0120**	⅔	KT
WS 270	15	0	−0·75	33·85	27·23	7·84	138	—	**N 70 V**	50–0	**0240**	—	—	A 5 x 28
		5	−0·75	33·85	27·23	7·85	136	—	,,	100–50				
		10	−0·75	33·85	27·23	7·91	135	—	,,	250–100				
		20	−0·75	33·85	27·23	7·82	137	—	,,	500–250				
		30	−0·75	33·85	27·23	7·86	138	—	,,	750–500				
		40	−0·72	33·86	27·23	7·85	136	—	**N 50 V**	100–0	—	**0415**		
		50	−0·72	33·89	27·26	7·86	138	—	**N 100 B**	116–0	**0500**	**0520**	⅔	KT
		60	−0·72	—	—	—	—	—	**N 70 B**					
		80	−0·72	33·92	27·29	7·92	138							
		100	−0·61	33·93	27·28	7·89	136							
		150	0·00	34·11	27·41	7·89	143							
		200	1·00	34·21	27·43	7·80	155							
		300	1·72	34·44	27·57	7·81	170							
		400	1·80	34·49	27·59	7·82	177							
		500	1·96	34·52	27·61	7·82	167							
		750	1·97	34·62	27·70	7·82	193							
		850	1·86	34·65	27·72	7·82	162							
WS 271	15	—	—	—	—	—	—	—	**N 100 B** **N 70 B**	91–0	0721	0741	⅔	KT
WS 272	15	0	−0·80	33·86	27·23	7·90	114	—	**N 70 V**	50–0	0910	—	—	A 5 x 28
		5	−0·80	33·87	27·25	7·92	116	—	,,	100–50				
		10	−0·80	33·87	27·25	7·90	119	—	**N 50 V**	100–0	—	0945		
		20	−0·80	33·87	27·25	7·91	111	—	**N 100 B**	87–0	0955	1015	⅔	KT
		30	−0·81	33·87	27·25	7·91	116	—	**N 70 B**					
		40	−0·83	33·91	27·28	7·90	112							
		50	−0·80	33·91	27·28	7·80	115							
		60	−0·78	33·92	27·29	7·75	143							
		80	−0·60	33·96	27·31	7·86	144							
		100	−0·40	33·97	27·32	7·85	143							
		130	−0·36	33·97	27·31	7·82	149							
WS 273	20	—	—	—	—	—	—	—	**N 100 B** **N 70 B**	124–0	0635	0655	⅔	KT
WS 274	20	0	−0·93	33·86	27·24	7·91	138	—	**N 70 V**	50–0	0810	—	—	A 6 x 28
		5	−0·94	33·86	27·24	7·89	144	7·85	,,	100–50				
		10	−0·95	33·86	27·24	7·89	143	—	,,	250–100				
		20	−0·96	33·86	27·24	7·88	144	7·97	,,	500–250				
		30	−0·96	33·87	27·25	7·89	141	—	,,	750–500				
		40	−0·96	33·87	27·25	7·89	147	7·96	,,	1000–750				
		50	−0·98	33·87	27·25	7·89	147	—	**N 50 V**	100–0	—	1035		
		60	−0·98	33·87	27·25	7·89	152	7·98	**N 100 B**	113–0	1132	1152	⅔	KT
		80	−1·00	33·87	27·25	7·90	156	—	**N 70 B**					
		100	−1·00	33·87	27·25	7·90	156	7·96						
		150	−1·09	33·94	27·31	7·89	162	7·76						
		175	0·50	34·13	27·39	7·74	162							
		200	1·20	34·23	27·44	7·74	179	5·36						
		300	1·77	34·43	27·56	7·66	177	4·47						
		400	1·97	34·52	27·61	7·71	162	4·13						
		500	2·01	34·58	27·66	7·81	159	4·07						
		750	1·87	34·61	27·69	7·79	153	4·13						
		1000	1·84	34·61	27·69	7·87	159	4·10						
WS 275	20	0	−0·99	33·86	27·24	7·86	138	—	**N 50 V**	100–0	1305	—	—	A 8 x 28
		5	−1·00	33·86	27·24	7·88	138	7·94	**N 70 V**	50–0				
		10	−1·00	33·87	27·26	7·90	138	—	,,	100–50				
		20	−0·96	33·87	27·26	7·90	141	7·82	,,	250–100				

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 275 *cont.*	53° 38′ 00″ S, 38° 34′ 00″ W	1928 4 ix										
WS 276	53° 45′ 00″ S, 38° 22′ 00″ W	4 ix	1850	2121	NW	2	NW	3	o. c. f.	1001·5	0·0	ship rolling heavily
WS 277	53° 52′ 30″ S, 38° 09′ 30″ W	5 ix	0800	132	NW	4–6	NW	4	c. f.	993·9	1·1	
WS 278	54° 23′ 00″ S, 35° 52′ 00″ W	12 ix	1800	238	NW	6–7	NW	6	b.	987·6	0·6	
WS 279	54° 23′ 00″ S, 35° 35′ 00″ W	13 ix	1800	—	NW	5–10	NW	4–7	o. q.	997·2	0·6	v. heavy sea
WS 280	54° 23′ 00″ S, 35° 18′ 00″ W	17 ix	1330	234	N	3–4	N	2	o. s.	986·0	− 1·7	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	BIOLOGICAL OBSERVATIONS Gear	Depth (metres)	TIME From	To	Length of tow (miles)	Remarks
WS 275 *cont.*		30	− 0·96	33·87	27·26	7·90	142	—	**N 70 V**	500–250				
		40	− 1·00	33·87	27·26	7·87	135	7·96	,,	750–500				
		50	− 1·01	33·88	27·27	7·85	128	—	,,	1000–760	—	1535		
		60	− 1·00	33·88	27·27	7·79	122	7·97	**N 100 B**	124–0	1700	1721	⅔	KT
		80	− 1·00	33·88	27·27	7·84	135	—	**N 70 B**					
		100	− 1·00	33·88	27·27	7·84	128	7·89						
		150	− 1·09	33·88	27·27	7·80	128	7·82						
		175	0·43	34·07	27·35	7·74	144							
		200	1·32	34·23	27·42	7·71	157	5·36						
		300	1·92	34·43	27·55	7·74	163	4·30						
		400	2·00	34·50	27·59	7·74	148	4·14						
		500	2·03	34·55	27·64	7·75	145	4·03						
		750	1·94	34·61	27·69	7·79	137	4·14						
		1000	1·74	34·67	27·75	7·86	157	4·18						
WS 276	20	0	− 0·58	33·87	27·24	7·91	129	—	**N 70 V**	50–0	**1850**	—	—	A 8 x 28
		5	− 0·58	33·87	27·24	7·89	126	7·73	,,	100–50				
		10	− 0·58	33·87	27·24	7·89	123	—	,,	250–100				
		20	− 0·58	33·87	27·24	7·89	133	7·59	,,	500–250				
		30	− 0·58	33·87	27·24	7·91	121	—	,,	750–520				
		40	− 0·58	33·87	27·24	7·81	130	7·72	,,	1000–760				
		50	− 0·58	33·90	27·26	7·86	135	—	**N 50 V**	100–0	—	**2135**		
		60	− 0·58	33·90	27·26	—	150	7·71	**N 100 B**	104–0	**2200**	**2220**	⅔	KT
		80	− 0·59	33·90	27·26	7·90	147	—	**N 70 B**					
		100	− 0·59	33·91	27·27	7·80	145	7·71						
		150	0·32	34·08	27·37	7·84	156	6·43						
		200	0·70	34·12	27·38	7·81	155	6·10						
		300	1·70	34·32	27·47	7·70	169	4·85						
		400	1·98	34·49	27·58	7·70	185	4·21						
		500	2·05	34·50	27·59	7·79	169	4·17						
		750	1·95	34·62	27·70	7·83	155	4·04						
		1000	1·75	34·72	27·79	7·87	155	4·10						
WS 277	21	0	− 0·54	33·89	27·25	7·92	134	—	**N 70 V**	50–0	0810	—	—	A 9 x 28
		5	− 0·56	33·89	27·25	7·92	125	7·72	,,	100–50				
		10	− 0·56	33·89	27·25	7·92	136	—	**N 50 V**	100–0	—	0830		
		20	− 0·58	33·89	27·25	7·93	145	7·80	**N 100 B**	124–0	0914	0935	⅔	KT
		30	− 0·58	33·89	27·25	7·93	136	—	**N 70 B**					
		40	− 0·56	33·89	27·25	7·87	126	7·67						
		50	− 0·56	33·90	27·26	7·92	131							
		60	− 0·56	33·91	27·27	7·85	156							
		80	− 0·56	33·91	27·27	7·87	150							
		100	− 0·57	33·91	27·27	7·92	135	7·70						
WS 278	28	0	− 1·20	33·80	27·21	7·89	117	—	**N 50 V**	100–0	**1815**	—	—	A 9 x 28
		5	− 1·20	33·80	27·21	7·89	122	—	**N 70 V**	50–0				
		10	− 1·20	33·80	27·21	7·89	126	—	,,	100–50				
		20	− 1·20	33·80	27·21	7·94	127	—	,,	200–120	—	**1905**		
		30	− 1·20	33·80	27·21	7·94	135	—	**N 100 B**	124–0	**1938**	**1958**	⅔	KT
		40	− 1·20	33·80	27·21	7·89	130	—	**N 70 B**					
		50	− 1·20	33·81	27·22	7·92	136							
		60	− 1·20	33·81	27·22	7·91	138							
		80	− 1·10	33·92	27·30	7·88	134							
		100	− 1·10	—	—	7·91	131							
		150	− 0·98	33·98	27·35	7·91	143							
		200	0·08	34·08	27·39	7·86	144							
WS 279	29	—	—	—	—	—	—	—	**N 100 B**	114–0	**1818**	**1838**	⅔	KT
									N 70 B					
WS 280	4	0	− 0·90	33·88	27·27	7·88	145	—	**N 50 V**	100–0	1340	—	—	A 9 x 28
		5	− 1·00	33·88	27·27	7·88	153	—	**N 70 V**	50–0				

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 280 *cont.*	54° 23′ 00″ S, 35° 18′ 00″ W	1928 17 ix										
WS 281	54° 23′ 00″ S, 35° 00′ 00″ W	17 ix	1635	—	N	3–4	N	2	o. s.	986·0	− 1·7	
WS 282	54° 22′ 30″ S, 34° 43′ 00″ W	17 ix	1810	2597	NE	3–4	NE	2	o. m.	987·1	− 2·0	
WS 283	54° 22′ 00″ S, 34° 25′ 00″ W	17 ix	2300	—	E	2	E	1	o. m.	988·4	− 1·1	
WS 284	54° 21′ 45″ S, 34° 08′ 00″ W	18 ix	0615	3640	E	1	E	1	c.	996·3	− 1·1	
WS 285	54° 21′ 30″ S, 33° 53′ 30″ W	18 ix	1010	—	—	0	—	0	b. c.	999·9	− 0·6	
WS 286	55° 00′ 00″ S, 32° 55′ 00″ W	18 ix	1830	4023	—	0	—	0	o.	1003·7	− 1·7	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.³	O_2 cc. p.l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
WS 280 *cont.*		10	−0·98	33·88	27·27	7·88	155	—	**N 70 V**	100–50				
		20	−1·00	33·88	27·27	7·87	156	—	,,	200–100	—	1425		
		30	−1·00	33·88	27·27	7·88	155	—	**N 100 B** **N 70 B**	92–0	1506	1526	⅔	KT
		40	−1·00	33·89	27·27	7·87	160	—						
		50	−0·98	33·89	27·27	7·86	155							
		60	−0·98	33·90	27·28	7·89	125							
		80	−0·93	33·90	27·28	7·89	123							
		100	0·85	33·92	27·29	7·91	126							
		150	−0·43	34·02	27·36	7·87	133							
		200	0·45	34·14	27·41	7·87	143							
WS 281	4	—	—	—	—	—	—	—	**N 100 B** **N 70 B**	102–0	1646	1706	⅔	KT
WS 282	4	0	−1·35	33·78	27·20	7·91	139	—	**N 50 V**	100–0	**1820**	—	—	A 10 x 28
		5	−1·35	33·78	27·20	7·94	143	—	**N 70 V**	50–0				
		10	−1·35	33·78	27·20	7·92	144	—	,,	100–50				
		20	−1·33	33·78	27·20	7·93	143	—	,,	250–100				
		30	−1·33	33·78	27·20	7·96	143	—	,,	500–250	—	**1919**		
		40	−1·35	33·78	27·20	7·95	143	—	**N 100 B** **N 70 B**	137–0	**2052**	**2112**	⅔	KT
		50	−1·35	33·82	27·23	7·95	144	—						
		60	−1·35	33·82	27·23	7·91	119							
		80	−1·35	33·82	27·23	7·92	125							
		100	−0·85	33·95	27·31	—	127							
		150	0·75	34·25	27·47	7·85	139							
		200	1·45	34·36	27·52	7·75	155							
		300	1·90	34·49	27·59	—	142							
		400	1·97	34·56	27·64	7·84	142							
		500	1·97	34·60	27·67	7·84	148							
WS 283	4	—	—	—	—	—	—	—	**N 100 B** **N 70 B**	78–0	**2320**	**2340**	⅔	KT
WS 284	5	0	−1·50	33·80	27·22	7·91	140	—	**N 50 V**	100–0	0625	—	—	A 10 x 28
		5	−1·50	33·80	27·22	7·90	136	7·75	**N 70 V**	50–0				
		10	−1·50	33·80	27·22	7·89	139	—	,,	100–50				
		20	−1·50	33·80	27·22	7·90	142	7·74	,,	250–100				
		30	−1·50	33·80	27·22	7·91	108	—	,,	500–250	—	0732		
		40	−1·50	33·80	27·22	7·93	125	7·98	**N 100 B** **N 70 B**	100–0	0848	0908	⅔	KT
		50	−1·50	33·80	27·22	7·92	99	—						
		60	−1·43	33·81	27·22	7·93	115	7·81						
		80	−1·35	33·83	27·24	—	112							
		100	−1·10	33·96	27·33	7·89	95	7·03						
		150	−0·30	34·05	27·37	7·85	117	6·43						
		200	0·00	34·15	27·44	7·86	122	5·90						
		300	1·70	34·51	27·62	—	—	4·28						
		400	1·81	34·54	27·64	7·90	117	4·27						
		500	1·58	34·60	27·70	7·91	125	4·43						
WS 285	5	—	—	—	—	—	—	—	**N 100 B** **N 70 B**	89–0	1021	1041	⅔	KT
WS 286	5	0	−1·45	33·85	27·25	7·87	121	—	**N 50 V**	100–0	**1835**	—	—	A 11 x 28
		5	−1·55	33·85	27·26	7·87	129	—	**N 70 V**	50–0				
		10	−1·60	33·85	27·26	7·89	129	—	,,	100–50				
		20	−1·59	33·85	27·26	7·86	121	—	,,	250–100				
		30	−1·64	33·85	27·26	7·87	126	—	,,	500–250				
		40	−1·65	33·86	27·26	7·88	128	—	,,	750–500				
		50	−1·70	33·93	27·32	7·85	131	—	,,	1000–780	—	**2050**		
		60	−1·73	33·93	27·32	7·84	136	—	**N 100 B** **N 70 B**	100–0	**2202**	**2222**	⅔	KT
		80	−1·73	33·97	27·36	7·80	162	—						
		100	−1·65	33·97	27·36	7·84	147							

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 286 *cont.*	55° 00′ 00″ S, 32° 55′ 00″ W	1928 18 ix										
WS 287	54° 54′ 00″ S, 32° 08′ 00″ W	19 ix	0800	4023	—	0	—	0	o. c.	1008·6	0·6	station worked inside light pack ice, a few miles from edge
WS 288	54° 52′ 00″ S, 32° 19′ 00″ W	19 ix	1410	—	N	2	N	1	c.	1011·5	– 1·7	station worked just outside edge of pack ice
WS 289	54° 55′ 30″ S, 35° 30′ 00″ W	1 x	1430	311	SW	5–7	SW	3–5	b.	1013·3	0·0	blowing v. heavily—station abandoned
WS 290	From											
	54° 23′ 10″ S, 35° 44′ 00″ W	1 x	2000	—	NW	3	NW	3	o. r. m.	1016·6	– 1·1	
	to											
	54° 12′ 45″ S, 35° 24′ 30″ W	2 x	0400	—	ESE	3	ESE	2	c.	1017·5	– 1·1	
WS 291	54° 53′ 00″ S, 35° 31′ 00″ W	2 x	0930	283	WSW	7	WSW	5	c.	1016·6	0·3	v. heavy sea
WS 292	55° 02′ 00″ S, 35° 16′ 40″ W	3 x	1500	113	WSW	3	WSW	2	o.	1018·5	2·2	light WSW swell

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
WS 286 *cont.*		150	− 0·15	34·22	27·50	7·78	153							
		200	0·18	34·43	27·65	7·78	153							
		300	1·02	34·60	27·74	7·71	156							
		400	1·21	34·68	27·80	7·78	153							
		500	1·22	34·68	27·80	7·82	149							
		750	1·01	34·70	27·83	7·81	139							
		1000	0·90	34·69	27·83	7·89	135							
WS 287	6	0	− 1·70	33·88	27·29	7·83	74	—	**N 50 V**	100–0	0815	—	—	A 12 x 28
		5	− 1·70	33·95	27·34	7·87	138	—	**N 70 V**	50–0				
		10	− 1·78	34·00	27·38	7·88	144	—	,,	100–50				
		20	− 1·78	34·00	27·38	7·87	139	—	,,	250–100				
		30	− 1·78	34·00	27·38	7·89	145	—	,,	500–250				
		40	− 1·79	34·00	27·38	7·85	150	—	,,	750–500				
		50	− 1·79	34·01	27·39	7·85	148	—	,,	1000–750	—	1055		
		60	− 1·79	34·02	27·40	7·85	145	—	**N 100 B**	164–0	1150	1220	1	KT
		80	− 1·70	34·02	27·40	7·83	145	—	**N 70 B**					
		100	− 1·52	34·02	27·40	7·81	145							
		150	0·50	34·34	27·56	7·77	143							
		200	0·78	34·54	27·71	7·76	141							
		300	1·18	34·61	27·74	7·79	144							
		400	1·14	34·61	27·75	7·78	144							
		500	1·21	34·62	27·76	7·86	145							
		750	0·88	34·63	27·78	7·91	141							
		1000	0·53	34·66	27·82	7·97	138							
WS 288	6	—	—	—	—	—	—	—	**N 100 B**	102–0	1429	1449	⅔	KT
									N 70 B					
WS 289	17	0	− 1·08	33·74	27·15	7·94	123	—	**N 70 V**	50–0	1430	1500	—	A 12 x 28
		5	− 1·12	33·75	27·16	8·00	107	7·98						
		10	− 1·12	33·75	27·16	7·90	123							
		20	− 1·12	33·74	27·15	7·94	134	8·10						
		30	− 1·12	33·75	27·16	7·95	134							
		40	− 1·12	33·74	27·15	7·96	139	7·38						
		50	− 1·12	33·75	27·16	7·95	144							
WS 290	17	—	—	—	—	—	—	—	**N 70 H**	0–5	**2000** /	**2015** /	—	32 consecutive hauls (A–GG) each of 15 mins. duration. Samples CC and DD lost. Sunset 1813; sunrise 0526
	18	—	—	—	—	—	—	—	,,	,,	**0345**	**0400**		
WS 291	18	0	− 1·08	33·75	27·16	7·96	155	—	**N 70 V**	200–100	1015	—	—	A 12 x 28
		5	− 1·10	33·75	27·16	7·97	137	—	,,	100–50				
		10	− 1·12	33·75	27·16	7·96	136	—	,,	50–0	—	1130		
		20	− 1·12	33·75	27·16	7·96	155	—	**N 100 B**	120–0	1227	1247	⅔	KT
		30	− 1·13	33·75	27·16	7·93	121	—	**N 70 B**					
		40	− 1·14	33·75	27·16	7·96	116							
		50	− 1·13	33·75	27·16	7·95	113							
		60	− 1·13	33·75	27·16	7·91	123							
		80	− 1·14	33·78	27·19	7·92	139							
		100	− 1·14	33·78	27·19	7·99	121							
		150	− 1·08	33·78	27·19	7·91	114							
		200	− 0·70	33·85	27·23	7·94	121							
		250	0·30	34·13	27·40	7·90	134							
WS 292	19	0	− 0·98	33·77	27·17	7·92	119	—	**N 70 V**	50–0	1505	—	—	A 13 x 28
		5	− 1·00	33·77	27·17	7·90	118	—	,,	100–50				
		10	− 1·04	33·77	27·17	7·92	124	—	**N 50 V**	100–0	—	1525		
		20	− 1·06	33·77	27·17	7·92	121	—	**N 100 B**	78–0	1604	1620	½	KT
		30	− 1·06	33·77	27·17	7·91	122	—	**N 70 B**					

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 292 *cont.*	55° 02′ 00″ S, 35° 16′ 40″ W	1928 3 x										
WS 293	55° 09′ 00″ S, 35° 05′ 00″ W	3 x	1710	130	WSW	3	WSW	2	o.	1018·5	2·2	light WSW swell
WS 294	55° 17′ 00″ S, 34° 53′ 00″ W	3 x	1935	—	WNW	4	—	—	o.	1018·1	0·0	W swell
WS 295	55° 23′ 40″ S, 34° 41′ 00″ W	3–4 x	2125	1741	NW	4	NW	3–4	o. s.	1017·6	– 0·3	
WS 296	55° 31′ 00″ S, 34° 29′ 00″ W	4 x	0325	—	W × N	6	W × N	5	o. m.	1013·8	0·3	
WS 297	55° 34′ 05″ S, 33° 14′ 00″ W	4 x	1015	2341	W × N	3–4	W × N	3	o.	1012·8	0·6	
WS 298	55° 27′ 30″ S, 32° 21′ 40″ W	5 x	0630	2267	NW	1–2	—	0	o.	1012·0	0·0	station worked 1 mile to windward of dense pack

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME From	TIME To	Length of tow (miles)	
WS 292 *cont.*		40	– 1·06	33·77	27·17	7·93	127							
		50	– 1·08	33·77	27·17	7·92	119							
		60	– 1·10	33·77	27·17	7·93	126							
		80	– 1·10	33·80	27·20	7·95	126							
		100	– 1·10	33·80	27·20	7·91	136							
WS 293	19	0	– 0·97	33·81	27·21	7·93	141	—	**N 50 V**	100–0	1720	—	—	A 15 x 28
		5	– 0·99	33·81	27·21	7·93	138	8·06	**N 70 V**	50–0				
		10	– 1·00	33·81	27·21	7·93	159	—	,,	100–50	—	1748		
		20	– 1·00	33·81	27·21	7·93	144	—	**N 100 B**	64–0	1806	**1823**	½	KT
		30	– 1·00	33·81	27·21	7·94	162	—	**N 70 B**					
		40	– 1·00	33·81	27·21	7·95	155	7·76						
		50	– 1·00	33·81	27·21	7·94	155							
		60	– 1·00	33·81	27·21	7·94	155							
		80	– 1·00	33·83	27·23	7·94	135							
		100	– 1·00	33·84	27·23	7·95	126	7·76						
WS 294	19	—	—	—	—	—	—	—	**N 100 B**	98–0	**1951**	**2011**	⅔	KT
									N 70 B					
WS 295	19–20	0	– 1·10	33·83	27·23	7·91	123	—	**N 50 V**	100–0	**2132**	—	—	A 15 x 28
		5	– 1·10	33·83	27·23	7·92	137	6·09	**N 70 V**	50–0				Considerable stray on wires
		10	– 1·12	33·83	27·23	7·93	138	—	,,	100–50				
		20	– 1·12	33·83	27·23	7·93	138	7·60	,,	250–100				
		30	– 1·13	33·83	27·23	7·92	133	—	,,	500–250				
		40	– 1·10	33·83	27·23	7·92	133	7·75	,,	750–500				
		50	– 1·11	33·83	27·23	7·91	137	—	,,	1000–750	—	**0108**		
		60	– 1·12	33·83	27·23	7·91	118	7·99	**N 100 B**	97–0	**0140**	**0200**	⅔	KT
		80	– 1·08	33·84	27·23	7·95	126	—	**N 70 B**					
		100	– 1·00	33·83	27·23	7·94	136							
		150	1·12	34·21	27·42	7·85	144	5·77						
		200	1·60	34·30	27·45	7·84	160	4·99						
		300	1·82	34·41	27·52	7·84	173	4·43						
		400	1·95	34·46	27·56	7·81	162	4·20						
		500	1·96	34·53	27·62	7·93	162							
		750	2·29	34·61	27·65	7·89	156	4·01						
		1000	1·95	34·72	27·77	7·95	119	4·06						
WS 296	20	—	—	—	—	—	—	—	**N 100 B**	110–0	**0338**	**0359**	⅔	KT
									N 70 B					
WS 297	20	0	– 1·60	33·90	27·30	7·90	116	—	**N 70 V**	50–0	1020	—	—	A 16 x 28
		5	– 1·68	33·88	27·29	7·94	134	—	,,	100–50				
		10	– 1·68	33·89	27·29	7·90	133	—	,,	250–100				
		20	– 1·70	33·88	27·29	7·90	131	—	,,	500–210				
		30	– 1·69	33·89	27·29	7·89	129	—	,,	750–500				
		40	– 1·70	33·90	27·30	7·91	128	—	,,	1000–750				
		50	– 1·70	33·90	27·30	7·89	129	—	**N 50 V**	100–0	—	1245		
		60	– 1·70	33·92	27·32	7·90	130	—	**N 100 B**	111–0	1330	1350	⅔	KT
		80	– 1·65	33·94	27·33	7·86	113	—	**N 70 B**					
		100	– 1·63	33·98	27·37	7·87	120							
		150	0·40	34·24	27·50	7·84	126							
		200	1·11	34·40	27·57	7·80	128							
		300	1·49	34·52	27·65	7·77	134							
		400	1·50	34·61	27·71	7·75	128							
		500	1·60	34·63	27·73	7·88	110							
		750	1·46	34·65	27·75	7·85	106							
		1000	1·32	34·68	27·79	7·90	103							
WS 298	21	0	– 1·76	33·92	27·32	7·87	143	—	**N 70 V**	50–0	0640	—	—	A. 17 x 28
		5	– 1·76	33·92	27·32	7·88	147	—	,,	100–50				
		10	– 1·78	33·94	27·33	7·89	149	—	,,	250–100				

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 298 *cont.*	55° 27′ 30″ S, 32° 21′ 40″ W	1928 5 x										ice. At end of station the ship had drifted right to edge of ice. Water v. transparent
WS 299	55° 18′ 30″ S, 32° 05 20″ W	5 x	1152	—	W	3	W	1	o.	1012·5	0·6	station worked at edge of pack ice
WS 300	55° 07′ 30″ S, 31° 56′ 55″ W	5 x	1400	4057	W	1	W	2	o.	1012·3	− 0·3	station worked at edge of pack ice
WS 301	55° 00′ 05″ S, 32° 08′ 25″ W	5 x	1900	—	NW	1	—	0	o. g	1013·5	− 0·6	station worked 8 miles outside pack ice
WS 302	54° 57′ 20″ S, 31° 49′ 35″ W	6 x	0455	—	—	0	—	0	o.	1012·6	− 1·0	station worked in edge of pack ice
WS 303	54° 51′ 25″ S, 31° 20′ 10″ W	6 x	0745	4590	—	0	—	0	o.	1013·4	− 0·6	much ice

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.³	O_2 cc. p.l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
WS 298 *cont.*		20	− 1·78	33·92	27·32	7·90	160	—	**N 70 V**	500–250				
		30	− 1·76	33·93	27·32	7·90	152	—	,,	750–500				
		40	− 1·76	33·95	27·34	7·89	155	—	,,	1000–800				
		50	− 1·75	33·94	27·33	7·89	155	—	**N 50 V**	100–0	—	0945		
		60	− 1·71	33·94	27·33	7·90	155	—	**N 100 B**	94–0	1008	1028	⅔	KT
		80	− 1·68	33·98	27·37	7·89	155	—	**N 70 B**					
		100	− 1·45	34·01	27·38	7·87	156							
		150	0·38	34·29	27·53	7·81	169							
		200	1·22	34·48	27·63	7·80	177							
		300	1·48	34·58	27·70	7·80	198							
		400	1·58	34·62	27·72	7·80	198							
		500	1·53	34·63	27·73	7·83	181							
		750	1·36	34·68	27·78	7·82	181							
		1000	1·17	34·69	27·80	7·85	181							
WS 299	21	—	—	—	—	—	—	—	**N 100 B**	100–0	1205	1225	⅔	KT
									N 70 B					
WS 300	21	0	− 1·63	33·96	27·35	7·89	163	—	**N 70 V**	50–0	1400	—	—	A 18 x 28
		5	− 1·66	33·97	27·36	7·94	137	—	,,	100–50				
		10	− 1·65	33·97	27·36	7·96	125	—	,,	250–100				
		20	− 1·65	33·96	27·35	7·91	127	—	,,	500–250				
		30	− 1·60	34·01	27·39	7·91	137	—	,,	750–520				
		40	− 1·58	33·98	27·37	7·93	152	—	,,	1000–750				
		50	− 1·58	34·01	27·39	7·91	138	—	**N 50 V**	100–0	—	1705		
		60	− 1·58	34·02	27·40	7·91	149	—	**N 100 B**	100–0	1736	1756	⅔	KT
		80	− 1·44	34·04	27·40	7·92	152	—	**N 70 B**					
		100	− 0·82	34·09	27·42	7·92	152							
		150	0·45	34·34	27·56	7·86	147							
		200	1·00	34·49	27·65	7·82	148							
		300	1·26	34·57	27·70	7·81	155							
		400	1·30	34·61	27·74	7·84	181							
		500	1·38	34·64	27·75	7·86	167							
		750	1·09	34·65	27·77	7·83	152							
		1000	0·70	34·66	27·81	7·90	167							
WS 301	21	—	—	—	—	—	—	—	**N 100 B**	88–0	1913	1937	⅘	KT
									N 70 B					
WS 302	22	—	—	—	—	—	—	—	**N 100 B**	98–0	0522	0542	⅔	KT
									N 70 B					
WS 303	22	0	− 1·68	33·97	27·36	7·90	148	—	**N 50 V**	100–0	0750	—	—	A 19 x 28
		5	− 1·70	33·98	27·37	7·91	147	—	**N 70 V**	50–0				
		10	− 1·70	33·98	27·37	7·91	152	—	,,	100–50				
		20	− 1·70	33·99	27·38	7·90	150	—	,,	250–100				
		30	− 1·75	33·98	27·37	7·90	157	—	,,	500–250				
		40	− 1·75	33·98	27·37	7·89	163	—	,,	750–500				
		50	− 1·76	34·01	27·39	7·89	163	—	,,	1000–750	—	1030		
		60	− 1·80	33·99	27·38	7·89	163	—	**N 100 B**	109–0	1312	1332	⅔	KT
		80	− 1·80	34·00	27·38	7·86	159	—	**N 70 B**					
		100	− 1·78	34·02	27·40	7·86	159							
		150	− 0·20	34·34	27·61	7·85	159							
		200	0·45	34·49	27·68	7·82	155							
		300	0·78	34·60	27·75	7·80	149							
		400	0·76	34·62	27·78	7·80	149							
		500	0·80	34·62	27·78	7·84	152							
		750	0·62	34·63	27·79	7·87	153							
		1000	0·43	34·63	27·80	7·86	153							

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 304	54° 54′ 40″ S, 30° 21′ 20″ W	1928 6 x	1830	4206	—	0	—	0	o.	1013·3	− 1·1	
WS 305	54° 44′ 00″ S, 29° 49′ 00″ W	7 x	0615	4572	NW	2	—	0	o. g.	1011·7	− 1·7	
WS 306	54° 41′ 50″ S, 30° 49′ 35″ W	7 x	1412	—	NW	3	—	0	c.	1009·0	− 1·6	v. many icebergs
WS 307	54° 19′ 30″ S, 30° 31′ 30″ W	7 x	1735	4572	NW	2	—	0	o. p. s.	1008·7	− 2·8	station worked 1 mile from edge of pack ice
WS 308	54° 04′ 05″ S, 30° 18′ 00″ W	8 x	0815	—	W × S	3	—	0	o. p. s.	1005·7	− 0·6	v. slight W swell

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
WS 304	22	0	–1·58	34·02	27·40	7·88	137	—	**N 100 B**	110–0	**1843**	**1908**	$\frac{5}{6}$	KT
		5	–1·60	34·02	27·40	7·88	135	—	**N 70 B**					A 22 x 28
		10	–1·58	34·02	27·40	7·90	135	—	**N 50 V**	100–0	**1920**			
		20	–1·65	34·02	27·40	7·89	135	—	**N 70 V**	50–0				
		30	–1·68	34·03	27·41	7·87	135	—	,,	100–50				
		40	–1·68	34·02	27·40	7·90	135	—	,,	250–100				
		50	–1·72	34·02	27·40	7·90	135	—	,,	500–250				
		60	–1·78	34·03	27·41	7·90	142	—	,,	750–500				
		80	–1·80	34·05	27·42	7·93	142	—	,,	1000–750	—	**2205**		
		100	–1·72	34·08	27·45	7·89	142							
		150	0·15	34·45	27·67	7·79	155							
		200	0·66	34·57	27·74	7·85	155							
		300	0·88	34·62	27·78	7·82	149							
		400	0·86	34·65	27·80	7·84	144							
		500	0·79	34·68	27·82	7·87	145							
		750	0·64	34·67	27·82	7·90	147							
		1000	0·46	34·67	27·83	7·90	148							
WS 305	23	0	–1·62	34·02	27·40	7·89	139	—	**N 50 V**	100–0	0620	—	—	A 23 x 28
		5	–1·62	34·02	27·40	7·88	145	—	**N 70 V**	50–0				
		10	–1·68	34·02	27·40	7·89	143	—	,,	100–50				
		20	–1·68	34·01	27·39	7·89	143	—	,,	250–100				
		30	–1·72	34·01	27·39	7·90	138	—	,,	500–250				
		40	–1·75	34·01	27·39	7·87	141	—	,,	750–500				
		50	–1·76	34·01	27·39	7·90	138	—	,,	1000–780	—	0905		
		60	–1·79	34·02	27·40	7·90	148	—	**N 100 B**	100–0	0945	1005	$\frac{2}{3}$	KT
		80	–1·80	34·02	27·40	7·91	149	—	**N 70 B**					
		100	–1·62	34·11	27·47	7·88	159							
		150	0·00	34·44	27·68	7·81	149							
		200	0·58	34·56	27·74	7·82	147							
		300	0·82	34·65	27·79	7·82	147							
		400	0·80	34·65	27·79	7·81	148							
		500	0·90	34·67	27·81	7·91	135							
		750	0·69	34·67	27·82	7·89	135							
		1000	0·49	34·68	27·84	7·94	145							
WS 306	23	—	—	—	—	—	—	—	**N 100 B**	105–0	1427	1447	$\frac{2}{3}$	KT
									N 70 B					
WS 307	23	0	–1·55	33·97	27·36	7·88	127	—	**N 100 B**	120–0	1751	1811	$\frac{2}{3}$	KT
		5	–1·55	33·97	27·36	7·88	134	—	**N 70 B**					A 24 x 28
		10	–1·56	33·99	27·38	7·89	123	—	**N 50 V**	100–0	**1840**			
		15	–1·70	—	—	—	—	—	**N 70 V**	50–0				
		20	–1·74	33·99	27·38	7·88	123	—	,,	100–50				
		30	–1·76	33·98	27·37	7·88	128	—	,,	250–100				
		40	–1·74	34·01	27·39	7·88	135	—	,,	500–250				
		50	–1·74	34·02	27·40	7·88	135	—	,,	750–500				
		60	–1·75	34·03	27·41	7·87	125	—	,,	1000–780	—	**2125**		
		80	–1·79	34·03	27·41	7·89	133							
		100	–1·80	34·03	27·41	7·87	125							
		150	–1·16	34·23	27·55	7·85	137							
		175	–0·02	34·46	27·69	7·77	147							
		200	0·75	34·50	27·67	7·80	143							
		300	0·68	34·64	27·80	7·80	143							
		400	0·68	34·67	27·82	7·79	135							
		500	0·66	34·68	27·83	7·84	135							
		750	0·54	34·68	27·84	7·87	135							
		1000	0·43	34·68	27·84	7·90	129							
WS 308	24	—	—	—	—	—	—	—	**N 100 B**	97–0	0830	0850	$\frac{2}{3}$	KT
									N 70 B					

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
		1928										
WS 309	53° 58′ 50″ S, 28° 50′ 10″ W	8 x	1600	—	SW	3	SW	2	o. g.	1004·9	− 1·1	station worked at edge of pack ice
WS 310	54° 00′ 00″ S, 28° 38′ 00″ W	8 x	1745	—	WSW	3	WSW	2	o. m. p. s.	1005·9	− 1·1	station worked in bay in edge of pack ice
WS 311	54° 45′ 00″ S, 35° 11′ 00″ W	10 x	1732	110	WNW	4	WNW	4	c.	1025·3	0·0	
WS 312	From 54° 00′ 00″ S, 36° 12′ 00″ W	17 x	1245	—	WSW	4–5	WSW	3–4	b. p. s. q.	987·5	1·1	
	to		1600	—	W × N	5	W × N	5	b. c.	993·9	− 2·8	W × N swell.
	53° 48′ 30″ S, 35° 46′ 30″ W		2000	—	WSW	7	WSW	7	b.	998·7	− 2·8	Mod. gale
WS 313	54° 48′ 00″ S, 33° 28′ 00″ W	5 xi	1015	—	N	3–4	N	1	o. f.	—	—	station worked on board whale catcher A.W. Sørle, ½ mile from pack ice
WS 314	53° 36′ 00″ S, 41° 05′ 00″ W	1 xii	1040	137 lt. gn. S. G. Po.	NE	3–4	NE	4	o. m. d.	975·2	3·2	
WS 315	53° 26′ 30″ S, 43° 49′ 00″ W	2 xii	1430	1774	W	2–3	SW	4	b.	995·4	2·3	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p. l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
WS 309	24	—	—	—	—	—	—	—	**N 100 B**	91–0	1610	1630	$\frac{2}{3}$	KT
WS 310	24	0	− 1·18	33·93	27·31	7·90	114	—	**N 100 B**	100–0	1800	1820	$\frac{2}{3}$	KT
		5	− 1·18	33·93	27·31	7·90	105	8·06	**N 70 B**					A 25 x 28
		10	− 1·18	33·93	27·31	7·92	106	—	**N 50 V**	100–0	**1835**			
		15	− 1·20	—	—	—	—	—	**N 70 V**	50–0				
		20	− 1·32	33·93	27·31	7·91	110	8·00	”	100–50				
		30	− 1·22	33·94	27·32	7·88	118	—	”	200–100				
		40	− 1·22	33·93	27·31	7·88	138	8·03	”	500–250				
		50	− 1·19	33·95	27·33	7·91	141	—	”	750–500				
		60	− 1·18	33·96	27·34	7·90	144	7·77	”	1000–750	—	**2055**		
		80	− 1·16	33·96	27·33	7·89	145							
		100	− 1·05	34·01	27·37	7·88	153	7·52						
		150	− 0·02	34·23	27·50	7·85	156	5·85						
		200	0·92	34·43	27·60	7·83	163	4·92						
		300	1·02	34·54	27·70	7·82	173	4·47						
		400	1·45	34·68	27·78	7·82	165	4·42						
		500	1·53	34·65	27·74	7·94	122	4·16						
		750	1·22	34·67	27·76	—	—	4·43						
		1000	1·04	34·67	27·80	7·97	122	4·29						
WS 311	26	—	—	—	—	—	—	—	**N 100 B**	116–0	1811	**1839**	1	KT. Nets fished for $\frac{1}{4}$ mile at 116 m.
									N 70 B					
WS 312	4	—	—	—	—	—	—	—	**N 100 B**	—	1431	1451	—	12 consecutive oblique hauls (B–M) each of approx. 20 mins. duration. Sunset 1844
									”	—	**1855**	**1913**		
WS 313	23	—	—	—	—	—	—	—	**N 100 B**	89–0	1039	1054	$\frac{1}{2}$	KT
									N 70 B					
WS 314	19	0	1·08	—	—	—	—	—	**N 70 V**	50–0	1045			
		5	1·00	—	—	—	—	—	”	100–50	—	—	—	water samples lost overboard
		10	1·00	—	—	—	—	—	**N 50 V**	100–0	—	1200		
		20	0·78	—	—	—	—	—	**N 100 B**	110–0	1300	1320	$\frac{2}{3}$	KT
		30	0·70	—	—	—	—	—	**N 70 B**					
		40	0·60											
		50	0·50											
		60	0·45											
		80	0·48											
		100	0·68											
		130	1·18	—	—	—	—	—	—	—	—	—	—	bottle struck bottom
WS 315	20	0	1·25	33·86	27·12	8·03	90	—	**N 70 V**	50–0	1615	—	—	A 21 xii 28
		5	1·20	33·86	27·13	8·06	100	—	”	100–50				
		10	1·15	33·86	27·13	8·08	106	—	”	250–100				
		20	1·08	33·86	27·13	8·06	108	—	”	500–250				
		30	1·03	33·86	27·14	8·08	105	—	”	750–500				
		40	1·00	33·86	27·14	8·08	106	—	”	1000–780				
		50	0·98	33·86	27·14	8·04	114	—	**N 50 V**	100–0	—	1930		
		60	0·95	33·87	27·16	8·04	114	—	**N 100 B**	122–0	1953	**2013**	$\frac{2}{3}$	KT
		80	0·28	33·91	27·23	7·97	118	—	**N 70 B**					
		100	0·58	33·96	27·26	7·92	131							
		150	1·20	34·12	27·35	7·87	169							

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 315 *cont.*	53° 26′ 30″ S, 43° 49′ 00″ W	1928 2 xii										
WS 316	52° 56′ 00″ S, 46° 26′ 00″ W	3 xii	1115	1723	W	3	—	4	o.	981·2	3·1	sea conf.
WS 317	52° 41′ 00″ S, 49° 39′ 30″ W	4 xii	0425	3369 d. G. R.	NW	3	NW	1	b. c. vis. 8	1004·2	6·7	heavy swell
WS 318	52° 26′ 00″ S, 52° 07′ 00″ W	4–5 xii	2005	3186	NW	3	NW	2	b. vis. 4	997·9	6·2	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.³	O_2 cc. p.l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
WS 315 *cont.*		200	1·30	34·19	27·40	7·84	179							
		300	1·91	34·40	27·52	7·80	188							
		400	2·00	34·49	27·58	7·79	200							
		500	2·07	34·55	27·63	7·79	188							
		600	2·03	34·61	27·69	7·87	185							
		800	1·95	34·63	27·70	7·84	200							
		1000	1·80	34·68	27·75	7·84	214							
		1500	1·21	34·68	27·80	7·89	179							
WS 316	21	0	1·88	33·88	27·11	8·07	107	—	**N 70 V**	50–0	1120	—	—	A 24 xii 28
		5	1·85	33·88	27·11	8·08	105	—	,,	100–50				
		10	1·78	33·88	27·12	8·09	104	—	,,	250–100				
		20	1·78	33·87	27·11	8·09	113	—	,,	500–250				
		30	1·73	33·87	27·11	8·08	105	—	,,	750–500				
		40	1·68	33·88	27·12	8·08	105	—	,,	1000–750				
		50	1·55	33·89	27·13	8·07	105	—	**N 50 V**	100–0	—	1635	—	net choked with diatoms—split on raising [out of water
		60	0·82	33·88	27·18	8·06	127							
		80	0·60	33·90	27·20	8·05	121	—	**N 100 B**	107–0	1656	1716	$\frac{2}{3}$	KT
		100	0·68	33·91	27·21	8·04	121							
		150	1·43	34·05	27·27	7·93	130							
		200	1·58	34·15	27·35	7·87	148							
		300	1·95	34·27	27·41	7·84	157							
		400	1·98	34·36	27·48	7·81	168							
		500	2·15	34·46	27·55	7·87	168							
		600	2·19	34·53	27·60	7·82	170							
		800	2·16	34·62	27·69	7·86	162							
		1000	2·04	34·64	27·71	7·89	170							
		1500	1·60	34·68	27·77	7·92	158							
		1650	1·44	34·68	27·78	7·90	158							
WS 317	22	0	4·49	34·10	27·04	8·04	103	—	**N 70 V**	50–0	0430	—	—	A 27 xii 28
		5	4·50	34·09	27·03	8·05	106	—	,,	100–50				
		10	4·50	34·09	27·03	8·05	106	—	,,	250–100				
		20	4·49	34·10	27·04	8·05	106	—	,,	500–250				
		30	4·46	34·11	27·05	8·05	106	—	,,	750–500				
		40	4·34	34·09	27·05	8·04	106	—	,,	1000–790	—	0705		
		50	4·27	34·10	27·06	8·04	111	—	**N 50 V**	100–0	0905	0915		
		60	4·13	34·10	27·08	8·04	113	—	**N 100 B**	120–0	0953	1013	$\frac{2}{3}$	KT
		80	3·41	34·09	27·15	8·04	115	—	**N 70 B**					
		100	2·96	34·07	27·17	8·04	116							
		150	2·73	34·07	27·19	7·98	121							
		200	2·74	34·11	27·22	7·95	142							
		300	2·64	34·20	27·30	7·95	146							
		400	2·40	34·27	27·38	7·87	153							
		500	2·54	34·33	27·41	7·90	160							
		600	2·50	34·40	27·47	7·87	168							
		800	2·42	34·47	27·54	7·90	168							
		1000	2·39	34·52	27·58	7·83	181							
		1500	2·27	34·63	27·68	8·20	149							
		3200	0·87	34·72	27·85	8·04	145							
WS 318	22–23	0	5·34	34·17	27·00	8·07	106	—	**N 70 V**	50–0	**2015**	—	—	A 27 xii 28
		5	5·35	34·18	27·01	8·05	111	—	,,	100–50	—	—	—	considerable stray on wires for earlier hauls
		10	5·34	34·17	27·00	8·08	115	—	,,	250–100				
		20	5·34	34·17	27·00	8·08	117	—	,,	500–250				
		30	5·34	34·18	27·01	8·08	113	—	,,	750–500				
		40	5·33	34·17	27·00	8·08	113	—	,,	1000–790				
		50	5·26	34·17	27·01	8·09	116	—	**N 50 V**	100–0	—	**2310**		
		60	5·07	34·18	27·04	8·09	123	—	**N 100 B**	180–0	**0109**	**0129**	$\frac{2}{3}$?	KT
		80	4·41	34·18	27·11	8·05	128	—	**N 70 B**					
		100	4·17	34·18	27·14	8·05	133							
		150	3·89	34·18	27·17	7·96	117							

Station	Position	Date	Hour	Sounding (metres)	WIND Direction	WIND Force	SEA Direction	SEA Force	Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
WS 318 *cont.*	52° 26′ 00″ S, 52° 07′ 00″ W	1928 4–5 xii										
WS 319	52° 01′ 00″ S, 54° 52′ 00″ W	5 xii	1340	1602 G. c. S.	NNW	3–4	NNW	3–4	b. vis. 7	987·7	8·8	finer material from bottom sample washed out
WS 320	53° 34′ 00″ S, 41° 06′ 00″ W	15–16 xii	2317	981	WNW	4	WNW	3	b. vis. 7	1007·1	2·5	
WS 321	53° 52′ 40″ S, 38° 10′ 00″ W	16 xii	1700	146	NNW	5	NW	6	o. r. vis. 4	994·3	2·2	
WS 322	53° 45′ 30″ S, 38° 23′ 00″ W	16–17 xii	2105	258 c. bl. S.	N	5	N	4	o. r.	998·1	2·8	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
WS 318 *cont.*		200	3·65	34·19	27·20	7·94	123							
		300	3·11	34·17	27·24	7·94	133							
		400	2·57	34·16	27·28	7·91	126							
		500	2·51	34·18	27·30	7·94	128							
		600	2·48	34·23	27·34	7·91	145							
		800	2·61	34·35	27·42	7·89	155							
		1000	2·48	34·46	27·52	7·84	170							
		1500	2·24	34·61	27·66	8·00	151							
		3000	1·39	34·72	27·82	7·92	109							
WS 319	23	0	6·11	34·16	26·90	8·12	105	—	**N 70 V**	50–0	1350	—	—	A 28 xii 28
		5	6·09	34·17	26·91	8·11	106	—	,,	100–50				
		10	6·09	34·16	26·90	8·11	107	—	,,	250–100				
		20	6·06	34·16	26·90	8·12	105	—	,,	500–250				
		30	6·04	34·16	26·91	8·12	108	—	,,	750–500				
		40	5·81	34·16	26·94	8·11	111	—	,,	1000–750				
		50	5·71	34·16	26·95	8·11	113	—	**N 50 V**	100–0	—	1615		
		60	5·42	34·16	26·98	8·09	117	—	**N 100 B**	102–0	1716	1736	$\frac{2}{3}$	KT
		80	5·14	34·16	27·02	8·06	125	—	**N 70 B**					
		100	4·39	34·16	27·10	8·05	136							
		150	4·41	34·24	27·16	7·96	117							
		200	4·24	34·23	27·17	7·92	123							
		300	3·34	34·20	27·24	7·90	133							
		400	3·33	34·18	27·22	7·91	140							
		500	3·07	34·16	27·23	7·91	140							
		600	2·84	34·20	27·28	7·91	140							
		800	2·71	34·30	27·38	7·89	153							
		1000	2·62	34·43	27·49	7·86	170							
		1500	2·37	34·61	27·65	7·80	160							
WS 320	3–4	0	1·85	33·94	27·16	8·04	109	—	**N 50 V**	100–0	**2325**	—	—	A 29 xii 28
		5	1·85	33·94	27·16	8·05	114	—	**N 70 V**	50–0				
		10	1·85	33·94	27·16	8·07	115	—	,,	100–50				
		20	1·83	33·96	27·18	8·05	119	—	,,	250–100				
		30	1·70	33·98	27·19	8·06	120	—	,,	500–250				
		40	1·69	33·98	27·19	8·06	123	—	,,	750–500				
		50	1·70	34·01	27·22	8·06	127	—	,,	900–750	—	**0300**		
		60	1·70	34·02	27·23	8·05	127	—	**N 100 B**	118–0	0334	0354	$\frac{2}{3}$	KT
		80	1·69	34·06	27·27	8·05	133	—	**N 70 B**	164–0	0420	0440	$\frac{2}{3}$	KT
		100	1·69	34·10	27·30	8·04	133							
		150	1·72	34·12	27·31	7·97	142							
		200	1·81	34·15	27·33	7·98	164							
		300	1·80	34·29	27·44	7·85	186							
		400	1·98	34·37	27·49	7·86	189							
		500	2·05	34·42	27·53	7·87	184							
		600	2·09	34·48	27·57	7·86	184							
		800	2·06	34·62	27·69	7·89	192							
		900	2·02	34·68	27·74	7·86	194							
WS 321	4	0	0·63	33·75	27·09	8·01	119	—	**N 50 V**	100–0	1705	—	—	A 2 i 29
		5	0·60	33·76	27·10	8·04	114	8·17	**N 70 V**	50–0				
		10	0·60	33·76	27·10	8·01	113	—	,,	100–50	—	1800		
		20	0·58	33·75	27·09	8·02	113	8·03	**N 100 B**	106–0	1845	1905	$\frac{2}{3}$	KT
		30	0·55	33·76	27·10	8·03	120	—	**N 70 B**					
		40	0·50	33·77	27·11	8·00	120	7·96						
		50	0·38	33·75	27·10	7·99	120							
		60	0·14	33·83	27·18	7·98	128	7·75						
		80	−0·03	33·91	27·25	7·95	139							
		100	−0·03	33·92	27·26	7·95	139	7·37						
WS 322	4–5	0	0·80	33·81	27·12	8·07	121	—	**N 50 V**	100–0	**2115**	—	—	A 2 i 29
		5	0·80	33·79	27·11	8·06	123	8·09	**N 70 V**	50–0				

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 322 *cont.*	53° 45′ 30″ S, 38° 23′ 00″ W	1928 16–17 xii										
WS 323	53° 38′ 30″ S, 38° 35′ 10″ W	20–21 xii	2210	2073	E	3	E	1	o. vis. 1	992·7	1·7	
		21 xii	0400	—	ESE	6–7	ESE	5	o. s. f. q. vis. 2	985·5	0·3	
WS 324	53° 31′ 40″ S, 38° 47′ 30″ W	21 xii	1015	—	SE × E	4–5	SE × E	5	o. s.	977·7	0·7	heavy swell
WS 325	53° 24′ 30″ S, 39° 00′ 00″ W	21 xii	1205	3603	S	4–5	S	5–3	o. s. vis. 7	975·2	1·4	v. heavy swell
WS 326	53° 17′ 10″ S, 39° 12′ 10″ W	21 xii	1920	—	S	7	S	7	o. r. vis. 5	975·7	0·6	
WS 327	53° 35′ 00″ S, 37° 50′ 00″ W	22 xii	0330	—	SW	7–8	SW	8–5	o. vis. 7	976·8	0·6	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME From	TIME To	Length of tow (miles)	
WS 322 *cont.*		10	0·80	33·79	27·11	8·04	128	—	**N 70 V**	100–50				
		20	0·80	33·81	27·12	8·06	128	8·08	,,	200–100	—	**2205**		
		30	0·78	33·81	27·12	8·05	135	—	**N 100 B** **N 70 B**	128–0	**2341**	**0001**	⅔	KT
		40	0·78	33·81	27·12	8·05	135	8·07						
		50	0·64	33·81	27·13	8·05	135							
		60	0·63	33·81	27·13	8·04	140	8·03						
		80	0·38	33·80	27·14	8·02	142							
		100	0·10	33·87	27·21	7·97	162	7·62						
		150	0·31	33·90	27·22	7·90	162	6·64						
		200	1·16	34·27	27·47	7·85	179	5·45						
		240	1·32	34·29	27·48	7·81	179	5·05						
WS 323	9–10	0	1·12	33·78	27·08	7·99	109	—	**N 50 V**	100–0	**2205**	—	—	A 3 i 29
		5	1·12	33·77	27·07	8·02	110	7·96	**N 70 V**	50–0	—	—	—	considerable stray on wires
		10	1·14	33·77	27·07	8·02	110	—	,,	100–50				
		20	0·84	33·78	27·10	8·01	117	8·06	,,	250–100				
		30	0·73	33·78	27·11	8·01	110	—	,,	500–250				
		40	0·65	33·78	27·11	8·01	110	8·04	,,	750–500				
		50	0·60	33·78	27·11	8·01	110	—	,,	1000–750	—	**0000**		
		60	0·55	33·80	27·13	8·00	114	7·91	**N 100 B** **N 70 B**	106–0	0342	0402	⅔	KT
		80	0·34	33·85	27·18	8·00	126	—						
		100	0·28	33·85	27·18	8·00	126	7·82						
		150	0·78	34·15	27·40	7·87	162	6·13						
		200	1·48	34·30	27·47	7·83	166	5·31						
		300	1·98	34·48	27·58	7·81	179	4·36						
		400	2·01	34·54	27·63	7·82	177	4·31						
		500	2·01	34·53	27·62	7·90	177							
		600	2·02	34·56	27·64	7·97	170	4·16						
		800	1·98	34·65	27·72	7·87	179	4·24						
		1000	1·87	34·66	27·73	7·88	179	4·15						
		1500	1·58	34·69	27·78	7·92	179							
		2000	1·17	34·70	27·82	7·92	162	4·77						
WS 324	10	—	—	—	—	—	—	—	**N 100 B** **N 70 B**	89–0	1029	1049	⅔	KT
WS 325	10	0	0·83	33·79	27·11	8·04	112	—	**N 50 V**	100–0	1210	—	—	A 3 i 29
		5	0·83	33·79	27·11	8·04	115	8·15	**N 70 V**	50–0	—	—	—	considerable stray on wires
		10	0·83	33·79	27·11	8·04	116	—	,,	100–50				
		20	0·83	33·79	27·11	8·04	118	7·84	,,	250–100				
		30	0·83	33·79	27·11	8·04	118	—	,,	500–250				
		40	0·83	33·80	27·11	8·05	116	8·01	,,	750–500				
		50	0·83	33·79	27·11	8·05	115	—	,,	1000–750	—	1545		
		60	0·83	33·79	27·11	8·05	116	7·99	**N 100 B** **N 70 B**	109–0	1756	1816	⅔	KT
		80	0·51	33·80	27·13	8·04	121	—						
		100	0·59	33·79	27·12	8·05	118	7·70						
		150	0·63	34·14	27·40	7·85	151	6·22						
		200	1·30	34·28	27·47	7·82	170	5·44						
		300	1·83	34·44	27·56	7·80	179	4·55						
		400	1·95	34·52	27·61	7·80	179	4·24						
		500	2·02	34·54	27·62	7·98	164	4·23						
		600	1·90	34·58	27·67	7·86	179	4·27						
		800	1·80	34·62	27·71	7·87	179	4·28						
		1000	1·67	34·66	27·75	7·89	179							
		1500	1·23	34·68	27·80	7·97	177	4·49						
		3250	0·22	34·63	27·82	7·96	177	5·01						
WS 326	10	—	—	—	—	—	—	—	**N 100 B** **N 70 B**	123–0	1929	1949	⅔	KT
WS 327	11	—	—	—	—	—	—	—	**N 100 B** **N 70 B**	109–0	0359	0419	⅔	KT

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 328	54° 04′ 00″ S, 36° 18′ 00″ W	1928 27 xii	1100	192 R.	E	2	E	2	p. s. vis. 7	989·8	1·7	
WS 329	53° 56′ 30″ S, 36° 06′ 00″ W	27 xii	1350	165 d. gy. gn. S.	E	3	E	2	o. vis. 6	990·1	3·2	
WS 330	53° 49′ 30″ S, 35° 53′ 30″ W	27 xii	1637	1031	ENE	2	E	2	o. vis. 6	989·3	1·6	
WS 331	53° 42′ 00″ S, 35° 40′ 40″ W	27 xii	2142	—	ENE	2	E	2	o.	989·3	1·6	
WS 332	53° 35′ 00″ S, 35° 29′ 00″ W	27–28 xii	2335	3813	ENE	5	ENE	4	f. s. vis. 6	988·0	0·5	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
WS 328	15	0	1·03	33·75	27·06	8·07	102	—	**N 50 V**	100–0	1105	—	—	A 4 i 29
		5	1·03	33·75	27·06	8·06	106	8·05	**N 70 V**	50–0				
		10	1·03	33·75	27·06	8·07	102	—	,,	100–50				
		20	1·00	33·74	27·06	8·07	102	8·24	,,	160–100	—	1200		
		30	0·76	33·75	27·08	8·05	107	—	**N 100 B**	102–0	1222	1242	⅔	KT
		40	0·60	33·79	27·12	8·05	111	8·02	**N 70 B**					
		50	0·50	33·79	27·13	8·05	115							
		60	0·40	33·79	27·13	8·06	120	7·98						
		80	0·23	33·79	27·14	8·05	120							
		100	0·12	33·83	27·18	8·05	128	7·86						
		150	0·23	33·98	27·29	7·90	149	6·79						
WS 329	15	0	1·25	33·79	27·08	8·07	102	—	**N 50 V**	100–0	1355	—	—	A 4 i 29
		5	1·21	33·80	27·09	8·08	111	8·31	**N 70 V**	50–0				
		10	1·15	33·79	27·09	8·08	113	—	,,	100–50	–	1430		
		20	1·03	33·78	27·09	8·08	120	8·17	**N 100 B**	110–0	1513	1533	⅔	KT
		30	0·98	33·79	27·10	8·08	123	—	**N 70 B**					
		40	0·95	33·78	27·09	8·07	124	8·08						
		50	0·89	33·79	27·10	8·07	127							
		60	0·50	33·78	27·12	8·06	139	7·89						
		80	0·26	33·83	27·17	8·01	148							
		100	0·23	34·00	27·31	7·95	157	6·95						
		150	0·68	34·10	27·36	7·89	174	6·22						
WS 330	15	0	0·82	33·83	27·14	8·05	109	—	**N 50 V**	100–0	1640	—	—	A 5 i 29
		5	0·80	33·83	27·14	8·05	112	8·15	**N 70 V**	50–0				
		10	0·74	33·83	27·14	8·05	112	—	,,	100–50				
		20	0·63	33·82	27·14	8·05	114	8·13	,,	250–100				
		30	0·62	33·82	27·14	8·05	114	—	,,	500–250				
		40	0·47	33·83	27·16	8·05	116	8·12	,,	750–500				
		50	0·25	33·83	27·17	8·04	118	—	,,	900–760	—	1930		
		60	0·22	33·83	27·17	8·03	124	8·08	**N 100 B**	146–0	2009	2029	⅔	KT
		80	0·10	33·83	27·18	8·00	124	—	**N 70 B**					
		100	0·20	33·89	27·22	7·97	131	7·54						
		125	—	34·06	—	7·87	151							
		150	0·94	34·18	27·41	7·85	166	5·81						
		200	1·38	34·26	27·45	7·81	179	5·25						
		300	1·85	34·43	27·55	7·79	186	4·50						
		400	2·00	34·50	27·59	7·79	181	4·20						
		500	2·03	34·58	27·65	7·87	174	4·15						
		600	2·00	34·60	27·67	7·90	170	4·12						
		800	1·87	34·62	27·70	7·86	181	4·22						
		950	1·84	34·66	27·73	7·88	186	4·27						
WS 331	15	—	—	—	—	—	—	—	**N 100 B**	110–0	**2152**	**2213**	⅔	KT
									N 70 B					
WS 332	15–16	0	0·58	33·78	27·11	8·07	100	—	**N 50 V**	100–0	**2340**	—	—	A 7 i 29
		5	0·56	33·78	27·11	8·07	105	8·26	**N 70 V**	50–0				
		10	0·54	33·78	27·12	8·07	107	—	,,	100–50				
		20	0·52	33·78	27·12	8·07	107	8·54	,,	250–100				
		30	0·50	33·78	27·12	8·07	100	—	,,	500–250				
		40	0·50	33·78	27·12	8·07	105	8·53	,,	750–500				
		50	0·48	33·78	27·12	8·07	106	—	,,	1000–750	—	**0245**		
		60	0·30	33·78	27·13	8·06	109	8·14	**N 100 B**	122–0	0538	0558	⅔	KT
		80	−0·10	33·78	27·15	8·05	123	—	**N 70 B**					
		100	−0·43	33·87	27·24	7·95	140	7·70						
		150	0·30	34·11	27·39	7·87	164	6·09						
		200	1·28	34·34	27·52	7·80	192	5·00						
		300	1·53	34·47	27·60	7·80	179	4·51						
		400	1·82	34·55	27·65	7·80	174	4·22						
		500	1·86	34·56	27·65	7·80	170	4·27						

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 332 *cont.*	53° 35′ 00″ S, 35° 29′ 00″ W	1928 27–28 xii										
WS 333	53° 28′ 00″ S, 35° 16′ 30″ W	28 xii	0850	—	ENE	6	ENE	6–7	o. q. vis. 6	984·4	1·2	
WS 334	53° 19′ 00″ S, 35° 10′ 30″ W	30 xii	0800	3705 lt. gy. Oz.	E	3	E	1	o. vis. 7	987·6	1·9	v. heavy swell
WS 335	53° 11′ 00″ S, 34° 55′ 00″ W	30 xii	1530	—	ESE	3	ESE	3	c. vis. 8	987·7	3·2	
WS 336	53° 06′ 00″ S, 34° 44′ 00″ W	30–31 xii	1720	3647 lt. gy. Oz.	SE	3	SE	1	b. c. vis. 8	988·6	0·5	v. heavy swell
WS 337	52° 59′ 30″ S, 34° 26′ 00″ W	31 xii	0220	—	S	3	S	3	c. vis. 8	992·0	0·5	
WS 338	53° 52′ 00″ S, 37° 06′ 00″ W	1929 7–8 i	2245	150	W	4	W	3	b. vis. 3	999·2	1·6	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p. l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
WS 332 *cont.*		600	1·86	34·59	27·68	7·86	170	4·25						
		800	1·74	34·66	27·74	7·86	174	4·34						
		1000	1·55	34·67	27·76	7·85	179	4·47						
		1500	1·34	34·67	27·78	7·91	181	4·75						
		3500	0·18	34·64	27·83	7·90	186	5·15						
WS 333	16	—	—	—	—	—	—	—	**N 100 B** **N 70 B**	95–0	0903	0923	$\frac{2}{3}$	KT
WS 334	18	0	0·43	33·78	27·12	7·99	112	—	**N 50 V**	100–0	0805	0815	—	A 7 i 29
		5	0·42	33·78	27·12	8·01	117	7·89	**N 70 V**	50–0	0850			
		10	0·42	33·77	27·11	7·95	119	—	,,	100–50				
		20	0·41	33·78	27·12	7·95	119	7·88	,,	250–100				
		30	0·40	33·78	27·12	7·96	119	—	,,	500–250				
		40	0·40	33·78	27·12	7·97	117	8·03	,,	750–510				
		50	0·40	33·82	27·15	7·96	120	—	,,	1000–770	—	1105		
		60	0·40	33·82	27·15	7·95	108	7·85	**N 100 B** **N 70 B**	128–0	1340	1403	$\frac{4}{5}$	KT. Nets fished at 128 m. for $\frac{1}{10}$ mile
		80	0·30	33·80	27·15	7·96	114	—						
		100	−0·37	33·83	27·20	7·95	116	7·81						
		125	—	33·97	—	7·92	145							
		150	−0·06	34·19	27·48	7·86	160	6·17						
		200	1·13	34·40	27·58	7·80	177	5·03						
		300	1·75	34·56	27·66	7·80	177	4·26						
		400	1·78	34·62	27·71	7·81	172	4·28						
		500	1·75	34·64	27·73	7·87	172	4·38						
		600	1·68	34·67	27·76	7·86	170	4·33						
		800	1·58	34·70	27·79	7·84	170	4·43						
		1000	1·34	34·70	27·80	7·90	179	4·48						
		1500	0·87	34·69	27·83	7·90	179	4·62						
		3500	0·01	34·65	27·84	8·12	151	4·37						
WS 335	18	—	—	—	—	—	—	—	**N 100 B** **N 70 B**	113–0	1536	1556	$\frac{2}{3}$	KT
WS 336	18–19	0	1·22	33·78	27·08	8·02	109	—	**N 50 V**	100–0	1820	—	—	A 8 i 29
		5	1·22	33·80	27·09	8·02	111	7·59	**N 70 V**	50–0				
		10	1·22	33·79	27·08	8·02	112	—	,,	100–50				
		20	1·22	33·81	27·10	8·03	109	7·58	,,	250–100				
		30	1·17	33·81	27·10	8·02	109	—	,,	500–250				
		40	1·15	33·81	27·10	8·02	105	7·74	,,	750–500				
		50	1·14	33·81	27·10	8·02	110	—	,,	1000–760	—	**2040**		
		60	1·13	33·80	27·10	8·01	108	7·72	**N 70 B**	109–0	**0047**	**0107**	$\frac{2}{3}$	KT
		80	0·00	33·81	27·17	7·97	116							
		100	−0·48	33·92	27·28	7·91	127	7·41						
		150	0·78	34·23	27·46	7·83	164	5·52						
		200	1·58	34·38	27·53	7·81	174	4·69						
		300	1·76	34·49	27·60	7·76	174	4·28						
		400	1·88	34·58	27·67	7·79	166	4·13						
		500	1·86	34·63	27·71	7·84	166	4·26						
		600	1·76	34·66	27·74	7·84	162	4·29						
		800	1·65	34·70	27·78	7·89	158	4·28						
		1000	1·43	34·69	27·79	7·89	155	4·36						
		1500	0·99	34·69	27·82	8·01	155	4·53						
		3000	0·20	34·66	27·84	7·95	164	4·73						
WS 337	19	—	—	—	—	—	—	—	**N 100 B** **N 70 B**	79–0	**0229**	**0249**	$\frac{2}{3}$	KT
WS 338	26–27	0	1·70	33·78	27·04	8·07	109	—	**N 50 V**	100–0	**2255**	—	—	A 11 i 29
		10	1·70	33·78	27·04	8·07	112	—	**N 70 V**	50–0				
		20	1·64	33·77	27·04	8·04	115	—	,,	100–50	—	**0005**		
		30	0·98	33·78	27·09	8·03	120	—	**N 100 B**	97–0	**0040**	**0058**	$\frac{3}{5}$	KT

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 338 *cont.*	53° 52′ 00″ S, 37° 06′ 00″ W	1929 7–8 i										
WS 339	53° 42′ 00″ S, 37° 09′ 00″ W	8 i	0240	180	W	3	W	1	c. vis. 8	998·6	1·1	
WS 340	53° 32′ 00″ S, 37° 12′ 30″ W	8 i	0640	740 sm. d. G.	W	3	W	2	c. vis. 8	999·3	2·2	
WS 341	53° 23′ 30″ S, 37° 08′ 00″ W	8 i	1105	1102 R.	SSW	3–4	SW	2	c. vis. 8	999·1	3·4	
			1330	—	—	—	—	—	s. f.	—	—	
WS 342	53° 12′ 00″ S, 37° 06′ 00″ W	8 i	1600	1154	SW	3	SW	2	c. vis. 8	1000·0	3·3	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
WS 338 *cont.*		40	0·90	33·78	27·10	8·04	120	—	**N 70 B**	97–0	**0040**	**0058**	$\frac{3}{5}$	KT
		50	0·90	33·78	27·10	8·04	120							
		60	0·84	33·78	27·10	8·04	121							
		80	0·70	33·78	27·11	8·02	130							
		100	0·56	33·78	27·12	8·00	130							
		140	0·28	33·85	27·19	8·00	132							
WS 339	27	0	1·53	33·80	27·07	8·02	109	—	**N 50 V**	100–0	**0245**	—	—	A 11 i 29
		10	1·53	33·80	27·07	8·02	115	—	**N 70 V**	50–0				
		20	1·35	33·80	27·08	8·04	116	—	,,	100–50				
		30	1·15	33·79	27·09	8·05	116	—	,,	160–100	—	**0325**		
		40	1·03	33·79	27·10	8·06	108	—	**N 70 B**	91–0	0353	0413	$\frac{2}{3}$	KT
		50	0·85	33·80	27·11	8·06	112	—	**N 100 B**	140–0	0435	0455	$\frac{2}{3}$	KT
		60	0·68	33·82	27·14	8·06	124							
		80	0·18	33·82	27·17	7·92	139							
		100	0·10	33·95	27·28	7·91	145							
		150	0·30	34·18	27·45	7·83	157							
WS 340	27	0	1·73	33·79	27·05	8·07	109	—	**N 50 V**	100–0	0645	—	—	A 11 i 29
		10	1·73	33·78	27·04	8·06	112	—	**N 70 V**	50–0				
		20	1·70	33·79	27·05	8·06	113	—	,,	100–50				
		30	1·28	33·78	27·07	8·05	114	—	,,	250–100				
		40	0·90	33·79	27·10	8·03	118	—	,,	500–250				
		50	0·83	33·78	27·10	8·02	120	—	,,	700–500	—	0825		
		60	0·78	33·79	27·11	8·00	124	—	**N 100 B**	90–0	0915	0935	$\frac{2}{3}$	KT
		80	0·52	33·79	27·12	8·00	124	—	**N 70 B**					
		100	0·45	33·84	27·17	8·00	126							
		150	0·48	34·07	27·35	7·86	151							
		200	1·18	34·22	27·43	7·82	170							
		300	1·78	34·41	27·54	7·78	170							
		400	1·95	34·47	27·57	7·77	170							
		600	2·01	34·60	27·67	8·02	143							
WS 341	27	0	1·33	33·78	27·07	8·05	105	—	**N 50 V**	100–0	1120	—	—	A 12 i 29
		10	1·30	33·78	27·07	8·05	108	—	**N 70 V**	50–0				
		20	1·23	33·78	27·07	8·05	103	—	,,	100–50				
		30	1·13	33·78	27·08	8·05	109	—	,,	250–100				
		40	1·10	33·78	27·08	8·06	115	—	,,	500–250				
		50	0·96	33·78	27·09	8·05	115	—	,,	750–500				
		60	0·45	33·78	27·12	8·06	116	—	,,	1000–770	—	1340		
		80	0·25	33·79	27·14	8·05	119	—	**N 100 B**	110–0	1403	1423	$\frac{2}{3}$	KT
		100	0·25	33·82	27·16	8·05	120	—	**N 70 B**					
		150	0·71	34·12	27·38	7·89	157							
		200	1·38	34·22	27·41	7·85	164							
		300	1·80	34·39	27·52	7·81	166							
		400	1·95	34·50	27·60	7·80	166							
		600	2·03	34·57	27·65	7·89	157							
		800	1·96	34·63	27·70	7·89	151							
		1000	1·83	34·67	27·75	7·92	146							
WS 342	27	0	1·63	33·78	27·04	8·01	115	—	**N 50 V**	100–0	1650	—	—	A 14 i 29
		10	1·63	33·78	27·04	8·00	118	—	**N 70 V**	50–0				
		20	1·61	33·77	27·04	8·00	120	—	,,	100–50				
		30	1·40	33·77	27·05	8·00	120	—	,,	250–100				
		40	1·15	33·77	27·07	8·01	120	—	,,	500–250				
		50	0·77	33·78	27·10	8·00	120	—	,,	750–500				
		60	0·65	33·78	27·11	8·00	123	—	,,	1000–780	—	1915		
		80	0·50	33·79	27·13	8·00	130	—	**N 100 B**	103–0	1931	1951	$\frac{2}{3}$	KT
		100	0·18	33·87	27·21	7·96	136	—	**N 70 B**					
		150	0·70	34·12	27·38	7·86	170							
		200	1·35	34·25	27·44	7·81	170							
		300	1·90	34·44	27·55	7·78	174							

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 342 *cont.*	53° 12′ 00″ S, 37° 06′ 00″ W	1929 8 i										
WS 343	53° 02′ 00″ S, 37° 06′ 00″ W	8–9 i	2105	2856 gn. gy. M.	SW	3	SW	3	b. vis. 3	1000·7	1·4	
WS 344	52° 50′ 00″ S, 37° 01′ 00″ W	9 i	0345	2215 c. G.	SSW	3	SSW	3	c. vis. 8	999·7	1·9	
WS 345	52° 41′ 00″ S, 37° 06′ 00″ W	9 i	1000	2174 c. G.	SW	2	SW	2	c. vis. 8	999·1	5·0	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p. l.	Gear	Depth (metres)	TIME From	TIME To	Length of tow (miles)	
WS 342 *cont.*		400	1·98	34·51	27·60	7·76	174							
		600	2·01	34·60	27·68	7·89	174							
		800	1·92	34·64	27·71	7·85	166							
		1000	1·79	34·67	27·75	7·96	166							
WS 343	27–28	0	1·93	33·77	27·02	8·02	105	—	**N 50 V**	100–0	**2110**	—	—	A 14 i 29
		10	1·92	33·77	27·02	8·02	105	—	**N 70 V**	50–0				
		20	1·91	33·78	27·03	8·02	108	—	,,	100–50				
		25	1·90											
		30	1·13	33·78	27·08	8·01	111	—	,,	250–100				
		40	1·04	33·78	27·09	8·00	116	—	,,	500–250				
		50	1·00	33·78	27·09	8·00	126	—	,,	750–500				
		60	0·82	33·79	27·11	8·00	124	—	,,	1000–750	—	**2335**		
		80	0·63	33·80	27·13	7·99	124	—	**N 100 B**	82–0	**0207**	**0231**	$\frac{4}{5}$	KT. Nets towed for $\frac{1}{8}$ mile at 82 m.
		100	0·32	33·84	27·18	7·97	126	—	**N 70 B**					
		150	0·60	34·11	27·38	7·84	160							
		200	1·40	34·26	27·45	7·81	170							
		300	1·90	34·43	27·55	7·78	174							
		400	2·00	34·50	27·59	7·76	174							
		600	2·06	34·57	27·65	7·86	174							
		800	1·96	34·62	27·69	7·85	166							
		1000	1·80	34·67	27·75	7·85	166							
		1500	1·41	34·68	27·78	7·85	166							
		2000	1·10	34·66	27·79	7·89	160							
WS 344	28	0	1·60	33·77	27·04	8·01	121	—	**N 50 V**	100–0	0350	—	—	A 15 i 29
		10	1·58	33·78	27·05	8·01	114	—	**N 70 V**	50–0				
		20	1·50	33·77	27·05	8·01	118	—	,,	100–50				
		30	1·39	33·77	27·06	8·00	118	—	,,	250–100				
		40	1·30	33·77	27·06	8·01	120	—	,,	500–250				
		50	1·04	33·77	27·08	8·00	124	—	,,	750–500				
		60	0·97	33·76	27·07	8·00	124	—	,,	1000–790	—	0615		
		80	0·39	33·79	27·13	8·00	124	—	**N 100 B**	80–0	0831	0851	$\frac{2}{3}$	KT
		100	0·16	33·90	27·23	7·95	142	—	**N 70 B**					
		150	0·96	34·14	27·38	7·84	157							
		200	1·62	34·31	27·47	7·81	164							
		300	1·94	34·46	27·57	7·78	166							
		400	2·00	34·60	27·67	7·76	166							
		600	1·95	34·66	27·73	7·81	162							
		800	1·85	34·69	27·76	7·80	—							
		1000	1·68	34·70	27·78	7·80	166							
		1500	1·21	34·70	27·81	7·87	166							
		2000	0·95	34·70	27·83	7·85	170							
WS 345	28	0	1·26	33·82	27·10	8·02	105	—	**N 50 V**	100–0	1005	—	—	A 15 i 29
		10	1·22	33·81	27·10	8·02	109	—	**N 70 V**	50–0				
		20	1·20	33·81	27·10	8·03	109	—	,,	100–50				
		30	0·83	33·81	27·12	8·03	113	—	,,	250–100				
		40	0·18	33·82	27·17	8·03	115	—	,,	500–250				
		50	0·14	33·82	27·17	8·03	124	—	,,	750–500				
		60	0·15	33·82	27·17	8·03	121	—	,,	1000–750	—	1215		
		80	− 0·03	33·88	27·23	7·97	130	—	**N 100 B**	98–0	1319	1339	$\frac{2}{3}$	KT
		100	− 0·04	33·99	27·31	7·91	148	—	**N 70 B**					
		150	0·58	34·17	27·43	7·86	160							
		200	1·60	34·36	27·51	7·81	166							
		300	1·95	34·50	27·60	7·79	166							
		400	2·00	34·58	27·66	7·78	168							
		600	1·96	34·65	27·72	8·05	158							
		800	1·78	34·69	27·76	8·08	153							
		1000	1·56	34·70	27·79	7·99	155							
		1500	1·17	34·69	27·81	7·91	166							
		2000	0·80	34·66	27·81	7·88	170							

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 346	52° 31′ 20″ S, 37° 07′ 00″ W	1929 9 i	1420	—	SW	2	SW	2	c. vis. 8	999·1	5·0	
WS 347	52° 23′ 30″ S, 37° 08′ 00″ W	9 i	1555	2524	SW	2	SW	2	c. vis. 8	1000·0	4·4	
WS 348	54° 23′ 10″ S, 35° 52′ 00″ W	11 i	1220	135 f. gy. M. Sh. Sp.	SE × E	4	SE × E	4	b. c. vis. 8	1008·2	2·2	
WS 349	54° 23′ 00″ S, 35° 32′ 30″ W	11 i	1505	267 f. gn. S.	S	4	S	4	c. vis. 8	999·5	1·9	
WS 350	54° 23′ 30″ S, 35° 17′ 00″ W	11 i	1720	256	S	4–5	S	4–5	c. vis. 7	1008·9	0·8	
WS 351	54° 21′ 30″ S, 34° 59′ 00″ W	11 i	1958	1170 gy. M. R.	S	4–5	S	4–5	c. vis. 7	1008·9	0·8	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
WS 346	28	—	—	—	—	—	—	—	**N 100 B** **N 70 B**	110–0	1428	1448	⅔	KT
WS 347	28	0	1·38	33·78	27·06	8·06	108	8·30	**N 50 V**	100–0	1557	—	—	A 16 i 29
		10	1·34	33·77	27·06	8·06	108	—	**N 70 V**	50–0				
		20	1·24	33·78	27·07	8·06	111	7·85	,,	100–50				
		30	1·14	33·77	27·07	8·06	113	—	,,	250–100				
		40	0·44	33·77	27·11	8·06	113	8·45	,,	500–250				
		50	−0·01	33·76	27·13	8·05	124	—	,,	750–500				
		60	−0·05	33·78	27·15	8·05	124	8·18	,,	1000–780	—	1820		
		80	−0·18	33·78	27·15	8·01	130	—	**N 100 B** **N 70 B**	140–0	1939	1959	⅔	KT
		100	−0·40	33·94	27·29	7·94	148	7·42						
		150	0·63	34·21	27·45	7·83	166	5·75						
		200	1·40	34·37	27·53	7·81	168	4·91						
		300	1·80	34·52	27·62	7·80	170	4·44						
		400	1·85	34·61	27·69	7·79	172	4·24						
		600	1·87	34·65	27·72	8·12	162	4·00						
		800	1·69	34·66	27·75	8·03	151	3·94						
		1000	1·42	34·67	27·77	7·95	164	4·40						
		1500	1·04	34·68	27·81	7·91	170	4·71						
		2000	—	34·68	—	7·90	172	4·83						
WS 348	1	0	1·36	33·82	27·10	8·03	106	—	**N 50 V**	100–0	1225	—	—	A 17 i 29
		10	1·30	33·83	27·11	8·01	106	—	**N 70 V**	50–0				
		20	1·25	33·81	27·10	8·03	117	—	,,	100–50	—	1245		
		30	1·23	33·82	27·10	8·02	116	—	**N 100 B** **N 70 B**	97–0	1334	1354	⅔	KT
		40	1·20	33·81	27·10	8·01	110	—						
		50	0·78	33·82	27·13	8·01	121							
		60	0·55	33·83	27·15	8·00	121							
		80	0·48	33·84	27·17	8·00	121							
		100	0·43	33·87	27·19	7·97	124							
WS 349	1	0	1·06	33·83	27·12	8·04	115	—	**N 50 V**	100–0	1510	—	—	A 17 i 29
		10	1·04	33·82	27·12	8·03	117	—	**N 70 V**	50–0				
		20	1·02	33·83	27·12	8·02	119	—	,,	100–50				
		30	1·03	33·85	27·14	8·02	123	—	,,	250–100	—	1545		
		40	0·86	33·84	27·15	8·01	116	—	**N 100 B** **N 70 B**	106–0	1614	1634	⅔	KT
		50	0·60	33·85	27·17	8·01	121	—						
		60	0·54	33·85	27·17	8·01	124							
		80	0·50	33·84	27·17	8·01	126							
		100	0·40	33·85	27·18	8·00	126							
		150	0·50	34·02	27·31	7·89	151							
		200	1·06	34·21	27·43	7·85	155							
WS 350	1	0	1·10	33·80	27·10	8·01	106	—	**N 50 V**	100–0	1735	—	—	A 17 i 29
		10	1·05	33·80	27·10	8·01	111	—	**N 70 V**	50–0				
		20	1·05	33·80	27·10	8·02	110	—	,,	100–50				
		30	1·05	33·80	27·10	8·01	110	—	,,	230–100	—	1810		
		40	1·01	33·81	27·11	8·02	113	—	**N 100 B** **N 70 B**	114–0	1842	1902	⅔	KT
		50	0·50	33·81	27·14	8·01	123	—						
		60	0·41	33·86	27·19	8·00	127							
		80	0·25	33·92	27·24	7·95	139							
		100	0·27	34·03	27·33	7·89	145							
		150	0·64	34·14	27·40	7·84	155							
		200	1·45	34·32	27·49	7·82	158							
WS 351	1	0	0·72	33·78	27·11	8·03	100	—	**N 50 V**	100–0	2000	—	—	A 18 i 29
		10	0·72	—	—	8·01	100	—	**N 70 V**	50–0				
		20	0·72	33·82	27·14	8·03	103	—	,,	100–50				
		30	0·72	—	—	8·02	108	—	,,	250–100				
		40	0·72	33·79	27·11	8·03	102	—	,,	500–250				
		50	0·65	33·79	27·12	8·02	105	—	,,	750–500				

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 351 *cont.*	54° 21′ 30″ S, 34° 59′ 00″ W	1929 11 i										
WS 352	54° 20′ 00″ S, 34° 42′ 00″ W	12 i	0023	2352	SSW	4	SSW	3	c. vis. 6	1007·4	0·5	
WS 353	54° 18′ 00″ S, 34° 25′ 00″ W	12 i	0610	4041 lt. gy. M.	SSW	4	SSW	4	c. vis. 8	1005·4	1·6	
WS 354	54° 23′ 20″ S, 34° 07′ 00″ W	12 i	1435	4750	SSW	4	SSW	4	c. vis. 7	1005·9	1·6	heavy swell

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME From	TIME To	Length of tow (miles)	
WS 351		60	0·60	33·79	27·12	8·02	110	—	**N 70 V**	1000–750	—	**2214**		
cont.		80	0·02	33·88	27·22	7·95	124	—	**N 100 B**	90–0	**2307**	**2327**	⅔	KT
		100	0·00	33·93	27·26	7·90	139	—	**N 70 B**					
		125	0·38	34·03	27·32	7·86	139							
		150	1·10	34·20	27·42	7·81	149							
		200	1·43	34·35	27·52	7·77	155							
		300	1·98	34·52	27·61	7·74	157							
		400	2·00	34·59	27·67	7·74	151							
		600	1·98	34·61	27·68	7·83	145							
		800	1·90	34·64	27·71	7·85	146							
		1000	1·71	34·65	27·74	7·82	146							
WS 352	2	0	0·60	33·78	27·11	8·01	106	—	**N 50 V**	100–0	**0027**	—	—	A 18 i 29
		10	0·60	33·78	27·11	8·00	108	—	**N 70 V**	50–0				
		20	0·60	33·78	27·11	8·00	110	—	,,	100–50				
		30	0·60	33·78	27·11	8·00	111	—	,,	250–100				
		40	0·60	33·79	27·12	8·02	109	—	,,	500–250				
		50	0·52	33·79	27·12	8·00	115	—	,,	750–510				
		60	0·15	33·86	27·20	7·92	131	—	,,	1000–750	—	**0255**		
		80	0·06	33·97	27·29	7·85	148	—	**N 100 B**	119–0	0420	0440	⅔	KT
		100	0·05	33·96	27·29	7·86	148	—	**N 70 B**	131–0	0455	0515	⅔	KT
		125	1·00	34·23	27·45	7·78	158							
		150	1·15	34·24	27·45	7·77	162							
		200	1·68	34·40	27·54	7·76	166							
		300	1·90	—	—	7·74	166							
		400	1·90	34·61	27·69	7·75	166							
		600	1·91	34·61	27·69	8·06	158							
		800	1·79	34·65	27·73	8·07	157							
		1000	1·56	34·66	27·76	7·90	153							
		1500	1·14	34·65	27·78	7·84	170							
		2000	0·63	34·65	27·81	7·80	170							
WS 353	2	0	0·63	33·71	27·05	8·25	99	—	**N 50 V**	100–0	0615	—	—	A 19 i 29
		10	0·59	33·71	27·06	8·15	106	—	**N 70 V**	50–0				
		20	0·55	33·72	27·07	8·12	113	—	,,	100–50				
		30	0·50	33·71	27·06	8·13	113	—	,,	250–100				
		40	0·50	33·71	27·06	8·12	112	—	,,	500–250				
		50	− 0·36	33·75	27·13	8·05	113	—	,,	750–500				
		60	− 0·41	33·78	27·16	8·01	127	—	,,	1000–750	—	0900		
		80	− 0·91	33·95	27·32	7·91	145	—	**N 100 B**	122–0	1212	1232	⅔	KT
		100	0·27	34·18	27·45	7·84	151	—	**N 70 B**					
		150	0·49	34·25	27·50	7·83	151							
		200	0·77	34·35	27·56	7·82	151							
		300	1·87	34·56	27·65	7·82	151							
		400	1·92	34·59	27·67	7·85	146							
		600	1·78	34·64	27·72	7·86	146							
		800	1·58	34·65	27·75	7·88	146							
		1000	1·24	34·66	27·78	7·87	149							
		1500	0·82	34·61	27·77	7·87	153							
		2000	0·52	34·61	27·78	7·89	155							
		3000	0·15	34·60	27·80	7·90	157							
WS 354	2	0	0·49	33·72	27·07	8·07	90	—	**N 50 V**	100–0	1440	—	—	A 19 i 29
		10	0·50	33·72	27·07	8·05	101	—	**N 70 V**	50–0				
		20	0·50	33·72	27·07	8·05	101	—	,,	100–50				
		30	0·50	33·72	27·07	8·05	106	—	,,	250–100				
		40	0·29	33·73	27·09	8·06	108	—	,,	500–250				
		50	− 0·26	33·82	27·19	7·98	118	—	,,	750–460				
		60	− 0·37	33·87	27·23	7·97	119	—	,,	1000–750	—	1745		
		80	− 0·55	33·89	27·26	7·96	124	—	**N 100 B**	128–0	1954	2014	⅔	KT
		100	− 0·79	34·05	27·39	7·87	139	—	**N 70 B**					
		150	− 0·01	34·28	27·55	7·83	140							

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
		1929										
WS 354 *cont.*	54° 23′ 20″ S, 34° 07′ 00″ W	12 i										
WS 355	54° 23′ 00″ S, 33° 49′ 00″ W	12–13 i	2130	3969	WSW	3	WSW	2	o. vis. 2	1004·0	1·1	
WS 356	54° 21′ 00″ S, 33° 27′ 00″ W	13 i	0415	4168 lt. y. gy. Oz.	W × S	3	WSW	3	o. vis. 8	1001·6	1·4	
WS 357	54° 55′ 30″ S, 35° 30′ 00″ W	13 i	1945	265 gn. M. G.	WNW	2	WNW	2	o. vis. 10	998·8	1·9	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.³	O_2 cc. p.l.	Gear	Depth (metres)	TIME From	TIME To	Length of tow (miles)	
WS 354 *cont.*		200	1·11	34·47	27·63	7·86	140							
		300	1·94	34·57	27·65	7·82	146							
		400	1·42	34·59	27·71	7·87	148							
		600	1·25	34·63	27·75	7·90	148							
		800	1·13	34·63	27·76	7·92	145							
		1000	0·96	34·63	27·77	7·95	149							
		1500	0·57	34·63	27·80	7·88	153							
		2000	0·46	34·61	27·79	7·92	155							
		3000	0·05	34·59	27·79	7·94	136							
WS 355	2–3	0	0·44	33·78	27·12	8·02	104	—	**N 50 V**	100–0	**2135**	—	—	A 21 i 29
		10	0·44	33·78	27·12	8·02	108	—	**N 70 V**	50–0				
		20	0·44	33·78	27·12	8·02	113	—	,,	100–50				
		30	− 0·01	33·79	27·15	8·00	124	—	,,	250–100				
		40	− 0·47	33·84	27·21	7·94	128	—	,,	500–250				
		50	− 0·51	33·84	27·22	7·93	133	—	,,	750–500				
		60	− 0·61	33·93	27·29	7·90	137	—	,,	1000–750	—	**0010**		
		80	− 0·50	34·13	27·45	7·85	149	—	**N 100 B**	100–0	**0252**	**0312**	⅔	KT
		100	0·20	34·30	27·55	7·83	151	—	**N 70 B**					
		150	0·72	34·43	27·63	7·81	151							
		200	1·17	34·52	27·67	7·81	151							
		300	1·32	34·61	27·73	7·81	151							
		400	1·39	34·65	27·76	7·83	151							
		600	1·25	34·65	27·77	—	151							
		800	1·04	34·66	27·79	7·95	151							
		1000	0·87	34·68	27·82	7·94	151							
		1500	0·44	34·66	27·83	7·94	153							
		2000	0·24	34·65	27·83	7·93	155							
		3000	0·01	34·64	27·84	7·94	160							
WS 356	3	0	0·40	33·79	27·13	8·07	108	8·21	**N 50 V**	100–0	0420	—	—	A 21 i 29
		10	0·39	33·81	27·15	8·07	110	—	**N 70 V**	50–0				
		20	0·44	33·82	27·15	8·06	113	8·19	,,	100–50				
		30	0·44	33·81	27·14	8·03	113	—	,,	250–100				
		40	0·27	33·82	27·16	8·02	109	8·17	,,	500–250				
		50	− 0·47	33·87	27·24	7·98	126	—	,,	750–500				
		60	− 0·54	33·87	27·24	7·96	126	8·10	,,	1000–750	—	0700		
		80	− 0·57	34·02	27·36	7·90	143	—	**N 100 B**	110–0	1000	1020	⅔	KT
		100	− 0·07	34·21	27·49	7·86	148	6·05	**N 70 B**					
		150	0·87	34·37	27·57	7·84	148	4·99						
		200	1·45	34·53	27·66	7·83	148	4·66						
		300	1·34	34·56	27·69	7·84	148	4·51						
		400	1·32	34·62	27·74	7·85	143	4·54						
		600	1·28	34·61	27·74	8·15	139	4·21						
		800	1·09	34·63	27·77	8·17	143	4·14						
		1000	0·86	34·65	27·80	8·05	148	4·38						
		1500	0·45	34·65	27·82	7·91	153	4·75						
		2000	0·24	34·64	27·82	7·91	155	4·90						
		3000	− 0·02	34·65	27·85	7·94	160	5·16						
WS 357	3	0	1·22	33·78	27·07	8·12	99	8·21	**N 50 V**	100–0	1950	—	—	A 22 i 29
		10	1·09	33·81	27·11	8·12	96	—	**N 70 V**	50–0				
		20	0·99	33·80	27·10	8·11	99	8·39	,,	100–50				
		30	0·99	33·78	27·09	8·11	101	—	,,	250–100	—	**2100**		
		40	0·95	33·79	27·10	8·11	99	8·08	**N 100 B**	114–0	**2128**	**2148**	⅔	KT
		50	0·94	33·78	27·09	8·11	102	—	**N 70 B**					
		60	0·94	33·79	27·10	8·10	102	8·01						
		80	0·65	33·79	27·12	8·07	105							
		100	0·49	33·82	27·15	8·02	111	7·68						
		150	0·79	34·06	27·33	7·89	131	6·28						
		200	1·05	34·19	27·41	7·88	139	5·74						

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 358	55° 02′ 30″ S, 35° 18′ 00″ W	1929 13–14 i	2251	113 R.	E	2	E	2	o. vis. 3	998·4	1·1	
WS 359	55° 11′ 00″ S, 35° 03′ 30″ W	14 i	0135	167 gn. M. R. c. G.	E	2	E	1	o. vis. 7	998·5	0·8	
WS 360	55° 17′ 00″ S, 34° 54′ 00″ W	14 i	0410	—	E	2	E	1	o. vis. 7	998·5	0·8	
WS 361	55° 24′ 00″ S, 34° 42′ 00″ W	14 i	0555	1445 c. G.	E	2	E	1	o. vis. 8	998·6	3·0	
WS 362	55° 31′ 00″ S, 34° 29′ 00″ W	14 i	1125	—	E	2	E	1	c. vis. 9	998·7	3·6	
WS 363	55° 38′ 00″ S, 34° 14′ 00″ W	14 i	1257	1332	NE	1–2	NE	1	s. vis. 4	998·4	1·4	
WS 364	55° 45′ 20″ S, 34° 04′ 00″ W	14 i	1700	—	NE	1–2	NE	1	s. vis. 4	998·4	1·4	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
WS 358	3–4	0	1·24	33·79	27·08	8·14	86	8·28	**N 50 V**	100–0	**2255**	—	—	A 22 i 29
		10	1·25	33·78	27·07	8·14	94	—	**N 70 V**	50–0				
		20	1·12	33·78	27·08	8·14	95	8·37	,,	100–50	—	**2330**		
		30	1·12	33·78	27·08	8·13	99	—	**N 100 B**	85–0	**2357**	**0012**	½	KT
		40	1·11	33·78	27·08	8·13	100	8·33	**N 70 B**					
		50	1·09	33·78	27·08	8·12	102							
		60	1·02	33·78	27·09	8·12	107	8·31						
		80	0·49	33·80	27·13	8·06	114							
		100	0·39	33·84	27·17	8·04	123	7·66						
WS 359	4	0	1·33	33·76	27·05	8·22	78	8·64	**N 50 V**	100–0	**0138**	—	—	A 22 i 29
		10	1·33	33·76	27·05	8·21	77	—	**N 70 V**	50–0				
		20	1·33	33·76	27·05	8·20	79	8·71	,,	100–50				
		30	1·27	33·76	27·06	8·19	80	—	,,	150–100	—	**0215**		
		40	1·24	33·76	27·06	8·18	77	8·60	**N 100 B**	114–0	**0303**	**0323**	⅔	KT
		50	1·06	33·76	27·07	8·16	89	—	**N 70 B**					
		60	0·57	33·80	27·13	8·08	105	8·04						
		80	0·49	33·80	27·13	8·07	105							
		100	0·39	33·82	27·15	8·06	107	7·81						
		150	0·42	33·97	27·27	7·94	123	6·48						
WS 360	4	—	—	—	—	—	—	—	**N 100 B**	130–0	0425	0445	⅔	KT
									N 70 B					
WS 361	4	0	1·09	33·82	27·11	8·12	97	8·24	**N 50 V**	100–0	0600	—	—	A 23 i 29
		10	1·09	33·81	27·11	8·12	93	—	**N 70 V**	50–0				
		20	1·09	33·81	27·11	8·11	93	8·06	,,	100–50				
		30	1·03	33·81	27·11	8·10	96	—	,,	250–100				
		40	1·02	33·80	27·10	8·10	101	8·03	,,	500–250				
		50	0·87	33·87	27·17	8·09	105	—	,,	750–500				
		60	0·44	33·83	27·16	8·08	115	7·89	,,	1000–750	—	0950		
		80	0·39	33·84	27·17	8·07	117	—	**N 100 B**	115–0	1003	1023	⅔	KT
		100	0·02	33·90	27·23	8·00	127	7·48	**N 70 B**					
		150	0·93	34·16	27·40	7·84	143	5·92						
		200	1·57	34·32	27·48	7·82	149	5·06						
		300	1·85	34·43	27·55	7·80	153	4·44						
		400	2·03	34·52	27·61	7·80	155	4·07						
		600	2·06	34·61	27·68	7·93	149	3·90						
		800	1·98	34·64	27·71	8·05	120	3·83						
		1000	1·83	34·66	27·74	8·05	149	4·05						
WS 362	4	—	—	—	—	—	—	—	**N 100 B**	105–0	1135	1155	⅔	KT
									N 70 B					
WS 363	4	0	1·44	33·82	27·09	8·12	89	8·10	**N 50 V**	100–0	1300	—	—	A 23 i 29
		10	1·31	33·82	27·10	8·12	92	—	**N 70 V**	50–0				
		20	1·13	33·82	27·11	8·12	93	8·11	,,	100–50				
		30	1·07	33·82	27·11	8·11	93	—	,,	250–100				
		40	1·07	33·82	27·11	8·11	94	8·07	,,	500–250				
		50	0·98	33·83	27·13	8·11	95	—	,,	750–500				
		60	0·69	33·83	27·15	8·11	102	7·96	,,	1000–750	—	1520		
		80	0·63	33·83	27·15	8·11	103	—	**N 100 B**	114–0	1546	1606	⅔	KT
		100	0·50	33·86	27·18	8·10	104	7·75	**N 70 B**					
		150	0·76	34·09	27·35	8·05	121	6·42						
		200	1·41	34·26	27·45	7·89	136	5·37						
		300	1·73	34·43	27·56	7·84	136	4·52						
		400	1·97	34·56	27·65	7·82	132	4·13						
		600	2·00	34·64	27·71	7·92	126	4·08						
		800	1·87	34·67	27·74	7·96	121	4·08						
		1000	1·81	34·67	27·75	7·93	124	4·28						
WS 364	4	—	—	—	—	—	—	—	**N 100 B**	114–0	1711	1731	⅔	KT
									N 70 B					

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 365	55° 52′ 10″ S, 33° 53′ 00″ W	1929 14 i	1830	3219 lt. gy. M. sm. St.	NE	4	NE	2–3	s. vis. 3	998·1	0·0	
WS 366	54° 38′ 50″ S, 36° 51′ 00″ W	15 i	1430	—	SW	2	SW	1	o. vis. 7	987·8	3·3	
WS 367	54° 44′ 10″ S, 37° 04′ 00″ W	15 i	1558	—	SW	2	SW	1	o. vis. 7	987·8	3·3	
WS 368	54° 51′ 30″ S, 37° 17′ 00″ W	15 i	1730	—	SW	2	SW	1	o. vis. 7	987·8	3·3	
WS 369	54° 58′ 00″ S, 37° 29′ 10″ W	15 i	1900	—	SW	4–5	SW	4	o. vis. 6	988·0	1·9	
WS 370	55° 05′ 30″ S, 37° 41′ 00″ W	15 i	2030	—	SW	4–5	SW	4	o. vis. 6	988·0	1·9	
WS 371	53° 55′ 00″ S, 36° 03′ 20″ W	21 i	1225	—	NW	4	NW	4	c. vis. 7	983·1	3·3	
WS 372	54° 08′ 30″ S, 35° 42′ 00″ W	21 i	1503	—	SE	4–5	SE	4	c. vis. 7	982·8	2·7	
WS 373	From 54° 10′ 00″ S, 35° 40′ 00″ W to 54° 27′ 00″ S, 34° 58′ 00″ W	21 i	1710	—	SE	4–5	SE	4	c. vis. 7	982·8	2·7	
			2000	—	S	2	S	1–2	c. vis. 7	984·5	1·6	
		22 i	0000	—	SE	2	SE	2	o. vis. 1–2	985·7	1·1	
			0400	—	SE	2	SE	2	o. s. vis. 4	986·0	0·0	
			0800	—	NW	1–2	—	0	o. s. vis. 2–4	987·1	0·0	
		22 i	0959	1540 gy. gn. M.								
WS 374	55° 09′ 00″ S, 40° 00′ 00″ W	6–7 ii	1845	3226 lt. gy. Oz.	SSW	5	SSW	4	o. vis. 8	1012·7	2·0	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME From	TIME To	Length of tow (miles)	
WS 365	4	0	1·27	33·88	27·15	8·06	106	8·30	**N 50 V**	100–0	1835	—	—	A 24 i 29
		10	1·27	33·87	27·14	8·07	114	—	**N 70 V**	50–0				
		20	1·27	33·88	27·15	8·07	114	8·15	,,	100–50				
		30	1·27	33·88	27·15	8·05	117	—	,,	250–100				
		40	1·22	33·88	27·15	8·07	124	8·01	,,	500–250				
		50	1·17	33·88	27·16	8·06	124	—	,,	750–500				
		60	1·11	33·89	27·17	8·06	132	7·86	,,	1000–750	—	**2100**		
		80	1·12	33·92	27·19	8·05	132	—	**N 100 B** **N 70 B**	104–0	**2323**	**2343**	$\frac{2}{3}$	KT
		100	1·13	33·98	27·24	7·97	145	7·23						
		150	1·54	34·12	27·32	7·87	160	6·21						
		200	1·67	34·19	27·37	7·86	162	5·78						
		300	1·81	34·33	27·47	7·88	166	4·88						
		400	2·04	34·45	27·55	7·83	174	4·35						
		600	2·05	34·54	27·62	7·82	170	4·32						
		800	2·34	34·61	27·65	8·02	170	3·98						
		1000	2·02	34·67	27·73	8·02	166	3·88						
		1500	1·66	34·75	27·82	8·03	166	4·17						
		2000	1·13	34·74	27·85	7·95	168	4·57						
		3000	0·42	34·72	27·88	7·89	170	4·89						
WS 366	5	—	—	—	—	—	—	—	**N 100 B** **N 70 B**	109–0	1440	1500	$\frac{2}{3}$	KT
WS 367	5	—	—	—	—	—	—	—	**N 100 B** **N 70 B**	116–0	1607	1627	$\frac{2}{3}$	KT
WS 368	5	—	—	—	—	—	—	—	**N 100 B** **N 70 B**	126–0	1738	1758	$\frac{2}{3}$	KT
WS 369	5	—	—	—	—	—	—	—	**N 100 B** **N 70 B**	122–0	1910	1930	$\frac{2}{3}$	KT
WS 370	5	—	—	—	—	—	—	—	**N 100 B** **N 70 B**	86–0	**2041**	**2101**	$\frac{2}{3}$	KT
WS 371	11	—	—	—	—	—	—	—	**N 100 B**	113–0	1239	1259	$\frac{2}{3}$	KT
WS 372	11	—	—	—	—	—	—	—	**N 100 B**	150–0	1512	1532	$\frac{2}{3}$	KT
WS 373	11	—	—	—	—	—	—	—	**N 100 B**	58–0	1730	1751	$\frac{2}{3}$	36 consecutive hauls (A–LL) each of approximately 20 mins. duration. Depth obtained by KT at intervals. Samples B, D and H lost. Sample R net torn. Sunset 2020; sunrise 0402
									,,	63–0	1843	1858	$\frac{2}{3}$	
	12	—	—	—	—	—	—	—	,,	87–0	**2312**	**2334**	$\frac{2}{3}$	
									,,	85–0	**0221**	**0239**	$\frac{2}{3}$	
									,,	60–0	0609	0628	$\frac{2}{3}$	
									,,	70–0	0655	0713	$\frac{2}{3}$	
									,,	,,	0939	0959	$\frac{2}{3}$	
WS 374	26–27	0	2·99	33·88	27·02	8·02	118	—	**N 50 V**	100–0	1900	—	—	A 19 iii 29
		10	2·99	33·88	27·02	8·03	118	—	**N 70 V**	50–0				
		20	2·99	33·88	27·02	8·01	118	—	,,	100–50				
		30	2·99	33·87	27·01	8·02	118	—	,,	250–100				
		40	2·99	33·88	27·02	8·02	119	—	,,	500–250				
		50	2·99	33·88	27·02	8·02	124	—	,,	750–500				
		60	2·76	33·88	27·04	8·02	124	—	,,	1000–720	—	**2220**		

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 374 *cont.*	55° 09′ 00″ S, 40° 00′ 00″ W	1929 6–7 ii										
WS 375	56° 16′ 00″ S, 41° 24′ 00″ W	7 ii	1800	3795	SW	6	SW	5	o. vis. 3	1010·9	2·8	
WS 376	57° 23′ 00″ S, 42° 52′ 00″ W	8 ii	1400	3191	W	3	W	3	o. vis. 6	1011·6	3·3	
WS 377	58° 34′ 00″ S, 44° 47′ 00″ W	9 ii	1440	2552 gy. Oz.	WNW	2	WNW	2	o. f. vis. 1–3	1004·1	3·3	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME From	TIME To	Length of tow (miles)	
WS 374 *cont.*		70	1·47	33·96	27·20	7·94	127	—	**N 100 B** **N 70 B**	133–0	**0021**	**0041**	⅔	KT
		80	0·67	33·95	27·24	7·93	130	—						
		100	0·69	34·00	27·28	7·92	133							
		150	1·59	34·13	27·33	7·91	139							
		200	1·59	34·18	27·37	7·90	146							
		300	1·97	34·34	27·47	7·82	148							
		400	2·21	34·47	27·55	7·80	151							
		600	2·18	34·57	27·63	7·81	151							
		800	2·18	34·59	27·65	7·89	151							
		1000	2·09	34·62	27·68	7·94	148							
		1500	1·70	34·72	27·79	7·93	151							
		2000	1·27	34·71	27·82	7·89	149							
		3000	0·49	34·66	27·83	7·90	151							
WS 375	27	0	2·09	33·87	27·08	7·93	118	—	**N 50 V**	100–0	1808	—	—	A 19 iii 29
		10	2·02	33·86	27·08	7·90	124	—	**N 70 V**	50–0				
		20	2·01	33·87	27·09	7·95	124	—	"	100–50				
		30	1·99	33·87	27·09	7·94	124	—	"	250–100				
		40	1·99	33·87	27·09	7·94	127	—	"	500–250				
		50	1·99	33·87	27·09	7·94	128	—	"	750–500				
		60	1·97	33·87	27·09	7·96	128	—	"	1000–750	—	**2140**		
		70	1·96	33·86	27·09	7·96	131	—	**N 100 B** **N 70 B**	125–0	**2317**	**2337**	⅔	KT
		80	− 0·06	33·89	27·23	7·91	135	—						
		100	− 0·10	34·00	27·32	7·89	148							
		150	1·11	34·23	27·44	7·86	153							
		200	1·52	34·31	27·47	7·82	160							
		400	2·03	34·52	27·61	7·80	164							
		600	2·00	34·64	27·71	7·79	162							
		800	1·91	34·67	27·74	7·92	160							
		1000	1·80	34·70	27·77	7·92	155							
		1500	1·33	34·70	27·80	7·89	155							
		2000	0·88	34·70	27·83	7·84	157							
		3000	0·30	34·67	27·84	7·84	158							
WS 376	29	0	1·45	33·79	27·07	7·97	105	—	**N 50 V**	100–0	1410	—	—	A 20 iii 29
		10	1·42	33·78	27·06	7·99	105	—	**N 70 V**	50–0				
		20	1·41	33·78	27·06	7·99	105	—	"	100–50				
		30	1·42	33·79	27·06	8·00	105	—	"	250–100				
		40	1·37	33·82	27·10	8·00	111	—	"	500–250				
		50	1·37	33·82	27·10	7·99	108	—	"	750–500				
		60	1·34	33·83	27·11	7·99	113	—	"	1000–750	—	1645		
		70	0·27	33·95	27·27	7·92	124	—	**N 100 B** **N 70 B**	100–0	1822	1842	⅔	KT
		80	− 0·39	34·02	27·35	7·89	126	—						
		100	− 0·38	34·11	27·42	7·87	130							
		150	0·51	34·32	27·55	7·81	136							
		200	0·94	34·45	27·63	7·73	136							
		300	1·48	34·56	27·68	7·80	136							
		400	1·41	34·64	27·75									
		600	1·37	34·68	27·79	7·79	131							
		800	1·25	34·67	27·79	7·86	131							
		1000	1·07	34·69	27·81	7·87	130							
		1500	0·65	34·69	27·84	7·90	139							
		2000	0·37	34·65	27·82	7·86	139							
		3000	− 0·11	34·62	27·81	7·86	139							
WS 377	29	0	1·33	33·90	27·16	7·94	124	—	**N 50 V**	100–0	1445	—	—	A 20 iii 29
		10	1·27	33·89	27·16	7·96	132	—	**N 70 V**	50–0				
		20	1·19	33·89	27·16	7·96	132	—	"	100–50				
		30	1·16	33·89	27·12	7·96	130	—	"	250–100				
		40	1·11	33·89	27·17	7·96	130	—	"	500–250				
		50	1·11	33·91	27·18	7·95	132	—	"	750–500				
		60	0·79	33·96	27·25	7·94	132	—	"	1000–740	—	1710		

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 377 *cont.*	58° 34′ 00″ S, 44° 47′ 00″ W	1929 9 ii										
WS 378	59° 20′ 20″ S, 45° 51′ 25″ W	10 ii	0950	2853	NE × N	2	NE	1	o. f. vis. 3	1003·4	0·3	
WS 379	59° 35′ 00″ S, 47° 15′ 00″ W	11–12 ii	2030	4047 gy. Oz.	WSW	3–4	WSW	2	o. vis. 1	995·6	1·9	
WS 380	60° 22′ 00″ S, 50° 33′ 00″ W	12 ii	2020	1365 c. G. R.	WNW	3–4	WNW	3	o. f. r. vis. 1	993·5	2·2	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
WS 377 *cont.*		80	0·81	34·12	27·37	7·82	145	—	**N 100 B**	132–0	1806	1826	⅔	KT
		150	1·37	34·41	27·57	7·79	157	—	**N 70 B**					
		200	1·84	34·53	27·63	7·73	157							
		300	1·97	34·60	27·68	7·79	157							
		400	1·53	34·61	27·72	7·78	157							
		600	1·60	34·69	27·78	7·80	157							
		800	1·38	34·67	27·78	7·83	155							
		1000	1·01	34·64	27·78	7·87	151							
		1500	0·63	34·63	27·79	7·87	151							
		2000	0·29	34·61	27·80	7·87	153							
WS 378	1	0	0·12	33·44	26·86	7·90	131	—	**N 50 V**	100–0	0958	—	—	A 21 iii 29
		10	0·09	33·43	26·86	7·91	133	—	**N 70 V**	50–0				
		20	0·02	33·55	26·96	7·91	137	—	,,	100–50				
		30	0·03	33·81	27·17	7·90	139	—	,,	250–100				
		40	0·53	33·99	27·29	7·89	140	—	,,	500–250				
		50	0·18	34·05	27·35	7·87	143	—	,,	750–500				
		60	0·11	34·14	27·43	7·87	146	—	,,	1000–750	—	1205		
		80	0·49	34·34	27·57	7·79	157	—	**N 100 B**	93–0	1317	1337	⅔	KT
		100	0·47	34·38	27·60	7·79	160	—	**N 70 B**					
		150	1·29	34·52	27·66	7·72	160							
		200	1·49	34·57	27·69	7·76	158							
		300	1·63	34·64	27·73	7·77	162							
		400	1·50	34·63	27·74	7·78	162							
		600	1·27	34·66	27·78	7·88	153							
		800	1·07	34·65	27·78	7·87	153							
		1000	0·71	34·62	27·78	7·87	153							
		1500	0·33	34·62	27·80	7·84	164							
		2000	0·08	34·61	27·81	7·86	164							
WS 379	2–3	0	0·74	33·93	27·22	7·91	136	—	**N 100 B**	118–0	**2041**	**2101**	⅔	KT A 21 iii 29
		10	0·73	33·92	27·21	7·91	136	—	**N 70 B**					
		20	0·60	34·01	27·30	7·89	140	—	**N 50 V**	100–0	**2115**			
		30	0·60	34·07	27·34	7·88	140	—	**N 70 V**	50–0				
		40	0·51	34·07	27·35	7·87	140	—	,,	100–50				
		50	0·43	34·08	27·36	7·79	148	—	,,	250–100				
		60	0·29	34·11	27·39	7·87	149	—	,,	500–250				
		80	– 0·05	34·25	27·52	7·75	149	—	,,	750–500				
		100	0·00	34·33	27·59	7·76	151	—	,,	1000–750	—	**2335**		
		150	0·01	34·41	27·65	7·79	162							
		200	0·46	34·49	27·69	7·70	155							
		300	0·62	34·55	27·73	7·80	155							
		400	0·83	34·55	27·72	7·80	162							
		600	0·91	34·62	27·77	7·91	158							
		800	0·59	34·61	27·78	7·93	158							
		1000	0·29	34·60	27·79	7·88	157							
		1500	0·21	34·60	27·79	7·88	166							
		2000	0·01	34·61	27·81	7·87	166							
		3000	– 0·22	34·60	27·82	7·84	164							
WS 380	3	0	– 0·19	33·70	27·09	7·89	148	—	**N 100 B**	113–0	**2025**	**2045**	⅔	KT
		10	– 0·10	33·78	27·15	7·92	153	—	**N 70 B**					
		20	0·03	33·89	27·23	7·89	155	—	**N 70 V**	50–0	**2115**	—	—	considerable stray on wires A 21 iii 29
		30	0·16	33·96	27·28	7·90	157	—	,,	100–50				
		40	0·23	34·08	27·37	7·90	157	—	,,	250–100				
		50	0·27	34·09	27·38	7·89	157	—	,,	500–250				
		60	0·26	34·14	27·42	7·87	157	—	,,	750–500				
		80	0·26	34·22	27·48	7·86	158	—	**N 50 V**	100–0	—	**0015**		
		100	0·29	34·23	27·49	7·84	160							
		200	0·47	34·48	27·68	7·85	160							
		300	0·61	34·58	27·75	7·83	166							
		400	0·59	34·56	27·74	7·82	170							

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 380 *cont.*	60° 22′ 00″ S, 50° 33′ 00″ W	1929 12 ii										
WS 381	61° 26′ 00″ S, 56° 19′ 00″ W	14 ii	2150	425 d. gy. S.	—	0	—	0	o. vis. 1	985·2	3·3	
WS 382	62° 15′ 35″ S, 58° 18′ 30″ W	15 ii	1331	425 br. gy. M.	WSW	5	WSW	3	b. vis. 8	989·3	4·4	
WS 383	62° 20′ 40″ S, 58° 13′ 00″ W	15 ii	1535	2085 d. gn. M.	WSW	5	WSW	3	b. vis. 8	989·3	4·4	
WS 384	62° 25′ 40″ S, 58° 06′ 10″ W	15 ii	1927	1957 gy. gn. M.	SW	4	SW	3	b. c. vis. 7	990·3	3·3	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.³	O_2 cc. p.l.	Gear	Depth (metres)	TIME From	TIME To	Length of tow (miles)	
WS 380 *cont.*		600	0·50	34·58	27·76	7·81	174							
		800	0·39	34·61	27·79	7·75	168							
		1000	0·35	34·61	27·79	7·89	160							
WS 381	5	0	1·65	34·02	27·23	7·79	136	—	**N 100 B**	104–0	**2155**	**2215**	⅔	KT
		10	1·54	34·04	27·26	7·91	143	—	**N 70 B**					A 22 iii 26
		20	1·32	34·04	27·27	7·96	149	—	**N 50 V**	100–0	**2225**			
		30	1·15	34·06	27·30	7·92	149	—	**N 70 V**	50–0				
		40	0·93	34·10	27·35	7·94	151	—	,,	100–50				
		50	0·71	34·11	27·37	7·91	153	—	,,	250–100				
		60	0·62	34·13	27·39	7·91	160	—	,,	400–250	—	**2325**		
		80	0·29	34·22	27·48	7·82	160							
		100	0·26	34·24	27·50	7·86	158							
		150	0·22	34·35	27·59	7·86	158							
		200	0·39	34·43	27·65	7·82	160							
		300	0·64	34·55	27·73	7·84	164							
		400	0·62	34·54	27·72	7·84	164							
WS 382	6	0	1·62	33·94	27·17	7·97	139	—	**N 50 V**	100–0	1335	—	—	A 22 iii 29
		10	1·58	33·95	27·18	7·96	143	—	**N 70 V**	50–0				
		20	1·41	33·94	27·19	7·95	143	—	,,	100–50				
		30	1·14	34·07	27·31	7·90	151	—	,,	250–100				
		40	0·91	34·11	27·36	7·91	158	—	,,	400–250	—	1423		
		50	0·82	34·14	27·39	7·90	158	—	**N 100 B**	116–0	1446	1506	⅔	KT
		60	0·69	34·19	27·44	7·86	151	—	**N 70 B**					
		80	0·68	34·23	27·47	7·83	151							
		100	0·69	34·29	27·52	7·82	157							
		150	0·57	34·31	27·54	7·74	149							
		200	0·37	34·41	27·63	7·77	157							
		300	0·51	34·51	27·70	7·76	160							
		400	0·53	34·60	27·78	7·76	158							
WS 383	6	0	2·09	34·00	27·18	7·90	135	—	**N 50 V**	100–0	1540	—	—	A 22 iii 29
		10	2·09	34·00	27·18	7·89	135	—	**N 70 V**	50–0	—	—	—	very great stray on wires
		20	1·59	34·04	27·26	7·88	135	—	,,	100–50				
		30	1·28	34·11	27·33	7·88	137	—	,,	250–100				
		40	0·95	34·11	27·35	7·85	145	—	,,	500–250				
		50	0·62	34·11	27·37	7·87	143	—	,,	750–480				
		60	0·44	34·19	27·45	7·85	145	—	,,	1000–730	—	1740		
		80	0·13	34·21	27·48	7·84	151	—	**N 100 B**	133–0	1843	1903	⅔	KT
		100	−0·11	34·29	27·56	7·84	153	—	**N 70 B**					
		150	−0·51	34·31	27·59	7·83	153							
		200	−0·68	34·37	27·65	7·83	153							
		300	−0·51	34·45	27·71	7·81	153							
		400	−0·88	34·52	27·78	7·82	157							
		600	−0·90	34·54	27·80	7·70	151							
		800	−0·72	34·55	27·80	7·85	157							
		1000	−0·94	34·54	27·80	7·84	157							
		1500	−1·47	34·58	27·85	7·85	157							
WS 384	6	0	2·13	34·05	27·22	7·92	130	—	**N 50 V**	100–0	1930	—	—	A 23 iii 29
		10	2·12	34·05	27·22	7·95	136	—	**N 70 V**	50–0				
		20	2·01	34·05	27·23	7·97	136	—	,,	100–50				
		30	1·12	34·12	27·35	7·88	137	—	,,	250–100				
		40	0·59	34·20	27·45	7·89	139	—	,,	500–250				
		50	0·44	34·22	27·47	7·89	142	—	,,	750–500				
		60	0·14	34·28	27·54	7·89	148	—	,,	1000–750	—	**2130**		
		80	−0·37	34·37	27·63	7·85	157	—	**N 100 B**	130–0	**2243**	**2303**	⅔	KT
		100	−0·72	34·43	27·70	7·87	155	—	**N 70 B**					
		150	−0·88	34·47	27·74	7·85	157							
		200	−0·92	34·47	27·74	7·86	157							
		250	−0·40	34·58	27·81	7·86	157							

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 384 *cont.*	62° 25′ 40″ S, 58° 06′ 10″ W	1929 15 ii										
WS 385	62° 32′ 00″ S, 57° 55′ 00″ W	16 ii	0001	1838 gn. gy. M.	SW	5–6	SW	3	o. f. vis. 0	991·0	2·2	
WS 386	62° 41′ 00″ S, 57° 44′ 00″ W	16 ii	0420	1392 c. gn. M. G.	WSW	6	WSW	3	b. c. vis. 6	991·6	2·2	
WS 387	62° 49′ 00″ S, 57° 40′ 00″ W	16 ii	0850	640 gn. M. bl. S.	SW	2–3	SW	2	o. f.	991·5	2·3	
WS 388	62° 55′ 30″ S, 57° 40′ 00″ W	16 ii	1220	446 gn. M. G. P.	NW	1	—	0	o. f. vis. 0	991·0	2·8	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.³	O_2 cc. p.l.	Gear	Depth (metres)	TIME From	TIME To	Length of tow (miles)	
WS 384 *cont.*		300	−0·31	34·62	27·84	7·84	157							
		350	−0·56	34·62	27·85	7·85	157							
		400	−0·61	34·62	27·85	7·86	157							
		600	−1·08	34·61	27·86	7·90	155							
		800	−1·19	34·61	27·86	7·90	157							
		1000	−1·48	34·63	27·89	7·79	160							
		1500	−1·56	34·67	27·92	7·96	157							
WS 385	7	0	1·30	33·69	26·99	7·96	130	—	**N 50 V**	100–0	0005	—	—	A 23 iii 29
		10	1·30	33·69	26·99	7·96	136	—	**N 70 V**	50–0				
		20	1·15	33·86	27·14	7·83	137	—	,,	100–50				
		30	0·93	34·08	27·33	7·95	140	—	,,	250–100				
		40	0·85	34·12	27·37	7·96	140	—	,,	500–250				
		50	−0·05	34·19	27·48	7·87	146	—	,,	750–500				
		60	−0·37	34·25	27·54	7·87	146	—	,,	1000–750	—	0215		
		80	−0·64	34·30	27·59	7·86	151	—	**N 100 B**	122–0	0301	0321	⅔	KT
		100	−0·71	34·43	27·70	7·86	151	—	**N 70 B**					
		150	−0·81	34·47	27·74	7·83	153							
		200	−0·86	34·52	27·78	7·85	153							
		300	−0·88	34·59	27·84	7·84	158							
		400	−1·00	34·59	27·84	7·82	160							
		600	−1·12	34·61	27·86	7·86	160							
		800	−1·33	34·62	27·88	7·85	164							
		1000	−1·52	34·63	27·89	7·86	160							
		1500	−1·63	34·67	27·93	7·85	160							
WS 386	7	0	1·06	33·58	26·92	7·88	124	—	**N 50 V**	100–0	0423	—	—	A 25 iii 29
		10	1·04	33·58	26·92	7·87	136	—	**N 70 V**	50–0				
		20	0·97	33·70	27·03	7·97	139	—	,,	100–50				
		30	1·31	34·01	27·25	7·95	145	—	,,	250–100				
		35	1·29	—	—	—	—	—	,,	500–250				
		40	0·92	34·00	27·27	7·97	140	—	,,	750–500				
		50	0·82	34·08	27·34	7·96	143	—	,,	1000–750	—	0637		
		60	0·27	34·14	27·42	7·84	148	—	**N 100 B**	123–0	0654	0714	⅔	KT
		80	−0·97	34·20	27·52	7·89	149	—	**N 70 B**					
		100	−0·90	34·27	27·58	7·88	155							
		150	−0·53	34·43	27·69	7·82	164							
		200	−1·19	34·47	27·75	7·79	160							
		300	−1·09	34·53	27·80	7·81	160							
		400	−0·94	34·56	27·81	7·84	158							
		600	−1·01	34·58	27·84	7·91	153							
		800	−1·16	34·58	27·84	7·87	157							
		1000	−1·33	34·58	27·84	7·85	157							
WS 387	7	0	1·29	34·09	27·32	7·92	139	—	**N 50 V**	100–0	0855	—	—	A 25 iii 29
		10	1·12	34·09	27·33	7·92	148	—	**N 70 V**	50–0				
		20	0·49	34·15	27·41	7·91	162	—	,,	100–50				
		30	−0·42	34·15	27·46	7·86	164	—	,,	250–100				
		40	−0·78	34·15	27·48	7·88	170	—	,,	500–250	—	0953		
		50	−1·05	34·20	27·53	7·86	177	—	**N 100 B**	93–0	1029	1049	⅔	KT
		60	−0·99	34·27	27·58	7·86	177	—	**N 70 B**					
		80	−1·09	34·28	27·59	7·86	174							
		100	−1·27	34·33	27·64	7·86	170							
		150	−1·07	34·45	27·73	7·85	170							
		200	−1·21	34·51	27·78	7·85	168							
		300	−0·95	34·53	27·79	7·84	174							
		400	−1·01	34·55	27·81	7·85	172							
		600	−0·97	34·56	27·82	7·85	172							
WS 388	7	0	0·72	34·14	27·39	7·96	172	—	**N 50 V**	100–0	1222	—	—	A 25 iii 29
		10	0·64	34·14	27·40	7·91	172	—	**N 70 V**	50–0				
		20	0·62	34·14	27·40	7·91	174	—	,,	100–50				

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 388 *cont.*	62° 55′ 30″ S, 57° 40′ 00″ W	1929 16 ii										
WS 389	63° 17′ 00″ S, 58° 51′ 05″ W	16 ii	2055	130 d. gn. M.	E	3	E	3	o. m. vis. 4–5	986·5	1·1	
WS 390	63° 10′ 30″ S, 59° 01′ 00″ W	16–17 ii	2350	749	NE	5	NE	4	o. r. vis. 1	981·7	1·9	
WS 391	63° 02′ 00″ S, 59° 12′ 00″ W	17 ii	0445	877 gn. M.	NE	7	NE	6	o. m. s. vis. 3–4	969·9	1·4	v. heavy sea
WS 392	62° 52′ 00″ S, 59° 26′ 00″ W	17 ii	1930	591 d. S.	ENE	7	ENE	6	m. o. vis. 2–5	971·9	1·1	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME From	TIME To	Length of tow (miles)	
WS 388 *cont.*		30	0·07	34·18	27·46	7·90	177	—	**N 70 V**	250–100				
		40	−0·27	34·23	27·52	7·88	177	—	,,	400–250	—	1318		
		50	−0·53	34·23	27·53	7·88	177	—	**N 100 B**	101–0	1348	1408	⅔	KT
		60	−0·78	34·24	27·55	7·88	177	—	**N 70 B**					
		80	−0·96	34·30	27·60	7·82	174							
		100	−1·04	34·33	27·63	7·81	174							
		150	−1·28	34·41	27·70	7·87	177							
		200	−1·31	34·43	27·72	7·85	177							
		300	−1·16	34·51	27·78	7·87	179							
		400	−1·13	34·51	27·78	7·86	179							
WS 389	7	0	1·01	34·10	27·34	7·87	124	—	**N 100 B**	104–0	**2108**	**2128**	⅔	KT
		10	1·19	34·09	27·32	7·96	133	—	**N 70 B**					A 26 iii 29
		20	0·51	34·20	27·45	7·87	145	—	**N 50 V**	100–0	**2145**			
		30	0·63	34·21	27·45	7·85	146	—	**N 70 V**	50–0				
		40	0·74	34·28	27·50	7·87	151	—	,,	100–50	—	**2210**		
		50	−0·49	34·35	27·62	7·85	153							
		60	−0·40	34·34	27·61	7·87	153							
		80	−0·55	34·40	27·67	7·90	157							
		100	−0·91	34·41	27·69	7·75	158							
WS 390	7–8	0	2·09	34·00	27·19	7·86	118	—	**N 50 V**	100–0	**2355**	—	—	A 26 iii 29
		10	2·09	34·00	27·19	7·97	124	—	**N 70 V**	50–0				
		20	2·03	34·01	27·20	7·95	124	—	,,	100–50				
		30	1·91	34·01	27·21	7·94	130	—	,,	250–100				
		40	1·42	34·01	27·24	7·95	133	—	,,	500–250	—	**0055**		
		50	0·74	34·09	27·35	7·95	133	—	**N 100 B**	76–0	**0244**	**0304**	⅔	KT
		60	0·37	34·09	27·37	7·82	133	—	**N 70 B**					
		80	−0·61	34·21	27·52	7·87	142							
		100	−0·76	34·27	27·57	7·86	142							
		150	−0·86	34·38	27·66	7·82	149							
		200	−0·91	34·45	27·72	7·85	149							
		300	−1·16	34·49	27·77	7·86	145							
		400	−1·12	34·50	27·77	7·88	143							
		600	−1·08	34·55	27·81	7·88	143							
WS 391	8	0	1·85	34·02	27·22	8·02	126	—	**N 50 V**	100–0	0450	—	—	A 26 iii 29
		10	1·89	34·01	27·21	7·99	127	—	**N 70 V**	50–0	—	—	—	great stray on wires
		20	1·87	34·02	27·22	7·99	127	—	,,	100–50				
		30	1·09	34·11	27·35	7·96	128	—	,,	250–100				
		40	0·59	34·15	27·41	7·87	132	—	,,	500–250				
		50	0·17	34·18	27·46	7·87	137	—	,,	750–500	—	0623		
		60	0·04	34·21	27·49	7·90	137	—	**N 100 B**	120–0	0751	0811	⅔	KT
		80	−0·31	34·25	27·54	7·88	139	—	**N 70 B**					
		100	−0·85	34·30	27·60	7·86	142							
		150	−0·86	34·42	27·69	7·84	145							
		200	−0·98	34·45	27·73	7·81	145							
		300	−0·96	34·52	27·78	7·82	146							
		400	−0·99	34·54	27·80	7·87	149							
		600	−1·07	34·56	27·82	7·87	148							
		800	−1·12	34·57	27·83	7·87	148							
WS 392	8	0	1·42	34·02	27·25	7·99	111	—	**N 50 V**	100–0	1935	—	—	A 27 iii 29
		10	1·36	34·03	27·26	7·90	117	—	**N 70 V**	50–0				
		20	1·29	34·05	27·28	7·97	119	—	,,	100–50				
		30	0·59	34·10	27·37	7·96	125	—	,,	250–100				
		40	−0·21	34·20	27·49	7·92	125	—	,,	400–250	—	**2050**		
		50	−0·21	34·23	27·52	7·86	131	—	**N 100 B**	120–0	**2134**	**2154**	⅔	KT
		60	−0·41	34·26	27·55	7·90	133	—	**N 70 B**					
		80	−0·56	34·27	27·56	7·87	136							
		100	−0·65	34·36	27·64	7·87	136							
		150	−0·71	34·37	27·65	7·87	139							

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 392 *cont.*	62° 52′ 00″ S, 59° 26′ 00″ W	1929 17 ii										
WS 393	62° 42′ 00″ S, 59° 41′ 00″ W	17–18 ii	2300 0015	1138 gn. M. 1051 gn. M.	W × N	1	W × N	1	o. s. vis. 0–1	974·4	1·9	
WS 394	62° 51′ 00″ S, 60° 40′ 00″ W	18 ii	0745	274 d. gy. M.	S	1	—	0	c. vis. 7	978·0	2·3	
WS 395	63° 48′ 30″ S, 62° 26′ 00″ W	19 ii	1330	297 gn. M.	NNE	3	NW	1	o. vis. 7–5	985·4	1·9	
WS 396	63° 38′ 30″ S, 62° 28′ 30″ W	19 ii	1610	318 gn. M. f. d. S.	NNE	3	NW	1	o. vis. 7–5	985·4	1·9	
WS 397	63° 29′ 25″ S, 62° 37′ 00″ W	19 ii	1900	150 d. S.	NE × N	4	NE × E	3	o. m. vis. 2–4	984·4	0·6	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
WS 392 *cont.*		200	− 0·79	34·51	27·77	7·87	139							
		300	− 1·05	34·52	27·79	7·87	139							
		400	− 1·08	34·54	27·80	7·83	139							
WS 393	8–9	0	1·59	33·86	27·11	7·96	109	—	**N 100 B**	117–0	**2340**	**0000**	⅔	KT
		10	1·59	33·85	27·10	7·97	118	—	**N 70 B**					A 26 iii 29
		20	1·49	33·86	27·12	7·92	113	—	**N 50 V**	100–0	**0015**			
		30	0·59	33·93	27·23	7·93	124	—	**N 70 V**	50–0				
		35	− 0·10	33·94	27·28	7·91	124	—	,,	100–50				
		40	− 0·28	33·95	27·29	7·89	130	—	,,	250–100				
		50	− 0·15	33·98	27·31	7·87	130	—	,,	500–250				
		60	− 0·08	34·02	27·34	7·85	133	—	,,	750–500				
		80	− 0·08	34·14	27·44	7·85	133	—	,,	900–650	—	**0245**		
		100	0·13	34·20	27·47	7·81	133							
		150	0·33	34·34	27·58	7·80	139							
		200	0·52	34·46	27·66	7·75	132							
		300	0·70	34·57	27·74	7·81	139							
		350	− 0·56	34·54	27·78	7·81	136							
		400	− 0·84	34·50	27·76	7·85	136							
		600	− 0·95	34·56	27·81	7·84	136							
		800	− 1·23	34·57	27·83	7·89	139							
		1000	− 1·33	34·55	27·82	—	—	—	—	—	—	—	—	bottle had touched bottom
WS 394	9	0	1·89	34·01	27·21	7·97	126	—	**N 50 V**	100–0	0759	—	—	A 26 iii 29
		10	1·89	33·99	27·19	7·96	128	—	**N 70 V**	50–0				
		20	1·89	33·98	27·18	7·96	131	—	,,	100–50				
		30	1·87	34·00	27·20	7·92	132	—	,,	200–100	—	0830		
		40	1·79	34·00	27·21	7·97	132	—	**N 100 B**	127–0	0859	0919	⅔	KT
		50	0·77	34·03	27·30	7·92	132	—	**N 70 B**					
		60	0·26	34·11	27·40	7·90	143							
		80	0·14	34·21	27·48	7·89	139							
		100	0·34	34·24	27·50	7·88	148							
		150	0·36	34·36	27·59	7·83	148							
		200	0·55	34·49	27·68	7·86	148							
WS 395	10	0	2·26	33·46	26·74	8·00	119	—	**N 50 V**	100–0	1333	—	—	A 28 iii 29
		10	2·26	33·43	26·72	8·01	120	—	**N 70 V**	50–0				
		20	2·23	33·44	26·73	8·00	123	—	,,	100–50				
		30	2·09	33·45	26·75	8·00	120	—	,,	250–100	—	1412		
		40	0·69	33·74	27·07	7·91	136	—	**N 100 B**	110–0	1446	1507	⅔	KT
		50	− 0·11	33·87	27·22	7·91	143	—	**N 70 B**					
		60	− 0·09	33·94	27·28	7·91	146							
		80	− 0·01	34·16	27·45	7·87	151							
		100	0·11	34·27	27·53	7·85	160							
		150	0·01	34·42	27·65	7·86	160							
		200	0·06	34·44	27·67	7·81	160							
WS 396	10	0	2·12	33·46	26·75	8·00	124	—	**N 50 V**	100–0	1615	—	—	A 28 iii 29
		10	2·05	33·47	26·77	8·00	128	—	**N 70 V**	50–0				
		20	1·91	33·49	26·79	7·99	130	—	,,	100–50				
		30	1·13	33·69	27·01	7·94	131	—	,,	250–100	—	1645		
		40	0·77	33·77	27·09	7·93	139	—	**N 100 B**	117–0	1733	1753	⅔	KT
		50	0·56	33·85	27·17	7·91	140	—	**N 70 B**					
		60	0·29	33·95	27·26	7·90	140							
		80	− 0·83	34·05	27·40	7·85	151							
		100	− 0·63	34·13	27·45	7·83	153							
		150	− 0·01	34·32	27·58	7·83	153							
		200	0·32	34·43	27·65	7·83	158							
		300	1·18	34·66	27·78	7·81	158							
WS 397	10	0	2·29	33·58	26·83	7·87	110	—	**N 50 V**	100–0	1905	—	—	A 28 iii 29
		10	1·79	33·71	26·98	8·00	188	—	**N 70 V**	50–0				

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 397 *cont.*	63° 29′ 25″ S, 62° 37′ 00″ W	1929 19 ii										
WS 398	63° 09′ 00″ S, 62° 27′ 00″ W	20 ii	0850	274 d. gn. S.	NW	3	NW	1	o. m. s.	988·1	0·5	
WS 399	62° 50′ 00″ S, 61° 58′ 30″ W	20 ii	1400	738 lt. gy. M. d. S.	NE	1	—	0	o. s. g. vis. 2–4	989·8	1·4	
WS 400	62° 07′ 00″ S, 62° 33′ 00″ W	21 ii	0415	4517 gy. Oz.	NNE	6	NNE	5	o. vis. 4–5	995·3	0·6	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
WS 397 *cont.*		20	1·45	33·87	27·13	7·97	118	—	**N 70 V**	100–50	—	1930		
		30	1·07	33·92	27·20	7·95	121	—	**N 100 B**	119–0	**2003**	**2023**	⅔	KT
		40	0·72	34·02	27·30	7·93	130	—	**N 70 B**					
		50	0·55	34·07	27·35	7·91	131							
		60	0·50	34·07	27·35	7·89	136							
		80	0·34	34·22	27·48	7·87	136							
		100	0·39	34·29	27·53	7·86	136							
		150	0·59	34·46	27·66	7·84	136							
WS 398	11	0	1·76	33·80	27·05	7·96	124	—	**N 50 V**	100–0	0855	—	—	A 28 iii 29
		10	1·50	33·87	27·13	7·96	136	—	**N 70 V**	50–0				
		20	1·22	33·89	27·16	7·95	136	—	"	100–50				
		30	1·09	33·90	27·18	7·87	136	—	"	250–100	—	0930		
		40	0·96	33·94	27·22	7·93	140	—	**N 100 B**	120–0	1000	1020	⅔	KT
		50	0·82	33·97	27·25	7·91	140	—	**N 70 B**					
		60	0·74	34·00	27·28	7·90	140							
		80	0·59	34·05	27·33	7·90	145							
		100	0·48	34·09	27·37	7·87	140							
		150	0·21	34·28	27·53	7·87	146							
		200	0·60	34·50	27·69	7·80	151							
WS 399	11	0	2·69	33·67	26·87	8·01	113	—	**N 50 V**	100–0	1405	—	—	A 29 iii 29
		10	2·68	33·66	26·86	8·00	115	—	**N 70 V**	50–0				
		20	2·59	33·74	26·94	8·03	116	—	"	100–50				
		30	2·12	33·76	26·99	8·00	114	—	"	250–100				
		40	0·10	33·83	27·18	7·93	126	—	"	500–250				
		50	−0·01	33·84	27·19	7·84	126	—	"	700–500	—	1515		
		60	−0·35	33·93	27·28	7·81	131	—	**N 100 B**	105–0	1541	1601	⅔	KT
		80	−0·34	34·05	27·38	7·81	137	—	**N 70 B**					
		100	−0·37	34·14	27·45	7·82	137							
		150	0·02	34·27	27·54	7·79	140							
		200	0·44	34·40	27·62	7·81	143							
		300	0·75	34·51	27·69	7·79	143							
		400	1·06	34·59	27·73	7·75	142							
		600	0·59	34·60	27·77	7·81	137							
		20	2·11	—	—	—	—	—	—	—	—	—	—	these temperatures observed between 1515 and 1530
		30	2·23											
		35	2·03											
		40	0·75											
		50	0·06											
WS 400	12	0	2·42	33·69	26·91	7·97	114	—	**N 50 V**	100–0	0430	—	—	A 29 iii 29
		10	2·46	33·65	26·88	7·99	119	—	**N 70 V**	50–0				
		20	2·46	33·65	26·88	8·01	119	—	"	100–50				
		30	2·47	33·68	26·90	7·89	139	—	"	250–100				
		40	1·59	33·71	26·99	7·99	124	—	"	500–250				
		50	0·34	33·77	27·12	7·97	124	—	"	750–500				
		60	0·06	33·78	27·14	7·98	126	—	"	1000–750	—	0700		
		80	−1·07	33·86	27·25	7·95	139	—	**N 100 B**	113–0	1014	1034	⅔	KT
		100	−0·66	34·00	27·35	7·88	146	—	**N 70 B**					
		150	0·53	34·30	27·53	7·82	151							
		200	1·14	34·45	27·61	7·74	151							
		300	1·63	34·56	27·67	7·74	151							
		400	1·66	34·60	27·70	7·81	151							
		600	1·72	34·66	27·74	7·75	131							
		800	1·55	34·68	27·77	7·87	151							
		1000	1·47	34·70	27·80	7·88	146							
		1500	1·11	34·70	27·82	7·90	151							
		2000	0·70	34·69	27·84	8·00	151							
		3000	0·44	34·69	27·85	7·93	151							

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 401	61° 20′ 00″ S, 63° 12′ 00″ W	1929 21–22 ii	1930	3566	NE × E	3–4	NE × E	3	o. vis. 1	1001·2	1·2	
WS 402	60° 32′ 00″ S, 63° 57′ 00″ W	22 ii	0850	3786	NE	3	NE	3	o. vis. 7	1001·4	1·9	
WS 403	59° 40′ 00″ S, 64° 35′ 00″ W	22–23 ii	2040	3721 gy. Oz. sm. St.	NE × E	3	NE × E	2	o. vis. 1	1003·5	2·2	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.³	O_2 cc. p.l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
WS 401	12–13	0	3·08	33·76	26·91	7·97	113	—	**N 50 V**	100–0	1935	—	—	A 29 iii 29
		10	3·08	33·76	26·91	8·00	115	—	**N 70 V**	50–0				
		20	3·08	33·77	26·92	7·92	124	—	,,	100–50				
		30	3·08	33·77	26·92	7·95	119	—	,,	250–100				
		40	2·71	33·77	26·95	7·92	119	—	,,	500–250				
		50	1·45	33·83	27·10	7·93	123	—	,,	750–500				water sample from 80 m. turbid
		60	0·70	33·87	27·18	7·93	131	—	,,	1000–750	—	**2200**		
		80	0·35	33·88	27·20	7·67	113	—	**N 100 B**	155–0	**0047**	**0107**	⅔	KT
		100	– 0·14	33·91	27·25	7·89	131	—	**N 70 B**					
		150	0·32	34·17	27·44	7·87	151							
		200	0·93	34·31	27·52	7·80	157							
		300	1·64	34·49	27·61	7·76	157							
		400	1·83											
		600	1·93	34·64	27·71	7·86	149							
		800	1·90	34·65	27·72	7·81	145							
		1000	1·78	34·69	27·76	7·87	145							
		1500	1·42	34·70	27·80	7·83	137							
		2000	1·13	34·69	27·81	7·83	145							
		3000	0·63	34·68	27·83	7·87	146							
WS 402	13	0	3·46	33·78	26·89	7·96	108	—	**N 50 V**	100–0	0900	—	—	A 30 iii 29
		10	3·47	33·78	26·89	7·97	113	—	**N 70 V**	50–0				
		20	3·47	33·77	26·88	7·94	118	—	,,	100–50				
		30	1·93	33·83	27·06	7·96	127	—	,,	250–100				
		40	1·48	33·82	27·09	7·97	125	—	,,	500–250				
		50	0·75	33·81	27·13	7·96	127	—	,,	750–500				
		60	– 0·51	33·87	27·24	7·96	139	—	,,	1000–750	—	1140		
		80	– 1·23	33·86	27·26	7·97	140	—	**N 100 B**	123–0	1331	1351	⅔	KT
		100	– 0·34	33·96	27·30	7·94	142	—	**N 70 B**					
		150	0·73	34·08	27·34	7·88	148							
		200	0·99	34·17	27·40	7·87	148							
		300	1·80	34·34	27·48	7·81	157							
		400	1·92	34·42	27·54	7·77	158							
		600	1·89	34·52	27·61	7·90	153							
		800	2·08	34·62	27·68	7·81	153							
		1000	2·04	34·63	27·69	7·84	153							
		1500	1·67	34·70	27·78	7·84	149							
		2000	1·43	34·68	27·78	7·90	149							
		3000	0·72	34·66	27·81	7·88	149							
WS 403	13–14	0	4·13	33·83	26·86	7·97	118	—	**N 50 V**	100–0	**2045**	—	—	A 1 iv 29
		10	4·14	33·83	26·86	8·02	116	—	**N 70 V**	50–0				
		20	4·13	33·83	26·86	8·01	123	—	,,	100–50				
		30	4·17	33·84	26·87	8·01	125	—	,,	250–100				
		35	4·16	—	—	—	—	—	,,	500–250				
		37·5	4·01	—	—	—	—	—	,,	750–500				
		40	3·75	33·84	26·91	7·96	127	—	,,	1000–750	—	**2355**		
		45	1·98	—	—	—	—	—	**N 100 B**	104–0	**0133**	**0153**	⅔	KT
		50	1·40	33·84	27·11	7·98	131	—	**N 70 B**					
		60	0·28	33·84	27·18	7·94	131							
		80	– 0·36	33·87	27·23	7·88	126							
		100	– 0·20	34·00	27·33	7·91	139							
		150	1·03	34·15	27·38	7·84	139							
		200	1·52	34·23	27·41	7·84	155							
		300	1·73	34·36	27·50	7·77	155							
		400	2·12	34·44	27·53	7·80	155							
		600	2·09	34·57	27·64	7·84	155							
		800	2·07	34·62	27·68	7·85	148							
		1000	1·96	34·66	27·73	7·85	148							
		1500	1·61	34·70	27·78	7·87	148							
		2000	1·26	34·68	27·79	7·77	151							
		3000	0·63	34·65	27·81	7·90	148							

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 404	58° 49′ 00″ S, 65° 15′ 00″ W	1929 23 ii	0840	3470	NNE	3–4	NNE	3	o. vis. 8	1003·2	3·9	heavy swell
WS 405	57° 53′ 00″ S, 66° 10′ 00″ W	23–24 ii	2102	2941	NNE	2	NNE	1	o. vis. 3	1004·1	4·7	
WS 406	56° 50′ 30″ S, 67° 03′ 00″ W	24 ii	0830	1234 lt. S. ca.	WSW	3	WSW	2	b. c.	1005·1	6·1	v. high long swell
WS 407	54° 10′ 00″ S, 63° 32′ 00″ W	25 ii	2140	130 sm. St.	W	2	W	4	b. c. vis. 4	977·9	8·3	high swell

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	*σt*	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
WS 404	14	0	5·29	33·92	26·81	8·06	113	—	**N 50 V**	100–0	0845	—	—	A 1 iv 29
		10	5·29	33·92	26·81	8·04	117	—	**N 70 V**	50–0				
		20	5·29	33·92	26·81	8·07	121	—	,,	100–50				
		30	5·29	33·92	26·81	8·07	119	—	,,	250–100				
		40	3·79	33·92	26·97	8·04	125	—	,,	500–250				
		50	3·19	33·93	27·04	7·99	125	—	,,	750–500				
		60	2·31	33·92	27·10	7·99	131	—	,,	1000–750	—	1040		
		80	1·13	33·94	27·21	7·83	137	—	**N 100 B**	112–0	1334	1354	⅔	KT
		100	0·84	33·97	27·25	7·87	137	—	**N 70 B**					
		150	0·52	33·98	27·28	7·96	142							
		200	1·40	34·10	27·32	7·97	148							
		300	1·83	34·23	27·39	7·86	153							
		400	2·28	24·39	27·48	7·82	155							
		600	2·05	34·48	27·57	7·81	157							
		800	2·14	34·59	27·65	7·83	157							
		1000	2·09	34·64	27·70	7·82	158							
		1500	1·75	34·68	27·76	7·84	151							
		2000	1·39	34·68	27·78	7·92	151							
		3000	0·82	34·65	27·80	7·88	153							
WS 405	14	0	6·48	33·96	26·69	8·06	111	—	**N 50 V**	100–0	**2110**	—	—	A 2 iv 29
		10	6·49	33·97	26·70	8·07	108	—	**N 70 V**	50–0				
		20	6·48	33·97	26·70	8·07	105	—	,,	100–50				
		30	6·31	33·98	26·73	8·07	108	—	,,	250–100				
		40	6·17	33·97	26·74	8·07	111	—	,,	500–250				
		50	6·12	33·97	26·75	8·07	106	—	,,	750–500				
		55	4·24	—	—	—	—	—	,,	1000–750	—	**2330**		
		60	4·01	34·03	27·03	7·94	123	—	**N 100 B**	96–0	**0057**	**0117**	⅔	KT
		80	3·49	34·05	27·10	7·99	124	—	**N 70 B**					
		100	3·39	34·05	27·11	7·94	120							
		150	2·89	34·07	27·17	7·96	125							
		200	2·73	34·06	27·18	7·92	127							
		300	2·65	34·11	27·23	7·90	128							
		400	2·62	34·14	27·27	7·90	132							
		600	2·61	34·28	27·37	7·83	142							
		800	2·50	34·43	27·50	7·80	148							
		1000	2·27	34·47	27·55	7·81	148							
		1500	2·20	34·60	27·66	7·82	146							
		2000	1·84	34·69	27·76	7·84	145							
WS 406	14	0	8·72	33·79	26·24	8·08	91	—	**N 50 V**	100–0	0834	—	—	A 2 iv 29
		10	8·72	33·81	26·25	8·10	91	—	**N 70 V**	50–0				
		20	8·72	33·79	26·24	8·14	89	—	,,	100–50				
		30	8·65	33·82	26·27	8·08	94	—	,,	250–100				
		40	8·44	33·91	26·37	8·09	95	—	,,	500–250				
		50	8·00	33·98	26·50	8·06	99	—	,,	750–500				
		60	7·55	33·99	26·57	8·03	108	—	,,	1000–750	—	1040		
		80	7·10	34·03	26·67	8·03	116	—	**N 100 B**	90–0	1055	1115	⅔	KT
		100	6·88	34·03	26·70	8·04	113	—	**N 70 B**					
		150	6·22	34·05	26·79	7·97	117							
		200	5·88	34·08	26·86	8·01	116							
		300	5·13	34·18	27·03	8·04	116							
		400	4·98	34·18	27·05	8·01	118							
		600	4·87	34·19	27·07	8·03	117							
		800	4·35	34·19	27·13	7·94	124							
		1000	3·49	34·30	27·30	7·87	139							
WS 407	15	0	7·37	33·87	26·50	7·97	99	—	**N 50 V**	100–0	**2150**	—	—	A 3 iv 29
		10	7·19	33·93	26·56	8·04	98	—	**N 70 V**	50–0	—	—	—	considerable stray on wire
		20	7·17	33·93	26·57	8·02	105	—	,,	100–50	—	**2207**		
		30	7·09	33·91	26·57	8·05	105	—	**N 100 B**	80–0	**2253**	**2307**	½	KT
		40	7·09	33·92	26·58	7·98	105	—	**N 70 B**					

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 407 *cont.*	54° 10′ 00″ S, 63° 32′ 00″ W	1929 25 ii										
WS 408	53° 50′ 00″ S, 62° 10′ 00″ W	26 ii	0915	454 f. gn. S.	SW	4	SW	4	b. c. r. vis. 8	979·2	7·9	high swell
WS 409	53° 10′ 00″ S, 60° 31′ 00″ W	26 ii	2010	567 f. gn. S.	W	5	W	4	b. c. vis. 7	981·0	8·3	v. heavy swell
WS 410	51° 56′ 00″ S, 55° 07′ 00″ W	13 iii	2030	—	NW	4	NW	3	b. vis. 8	1003·5	8·9	
WS 411	52° 08′ 00″ S, 52° 35′ 00″ W	14 iii	0805	—	—	1	NW	1	b. vis. 7	1009·1	8·3	
WS 412	52° 18′ 00″ S, 49° 58′ 00″ W	14 iii	1850	—	N	4	NNW	3	b. c. vis. 7	1004·6	7·2	
WS 413	52° 30′ 00″ S, 47° 10′ 00″ W	15 iii	1253	—	W × N	2	W × N	1	f. vis. 1	999·4	7·8	
WS 414	52° 41′ 00″ S, 44° 32′ 00″ W	16 iii	0530	—	NW	2	—	—	c. vis. 1–5	998·7	5·6	
WS 415	53° 02′ 30″ S, 41° 40′ 00″ W	16 iii	1742	—	SE	2	—	—	o. f. vis. 1	998·5	4·2	
WS 416	53° 23′ 00″ S, 38° 55′ 00″ W	17 iii	1644	—	SSE	3	SW	2	m. f. vis. 2–4	1000·0	3·8	
WS 417	54° 53′ 40″ S, 36° 23′ 10″ W	10 iv	1930	205 gy. gn. M. sm. P.	NW	2	NW	1	b. vis. 2	1014·5	– 0·6	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p. l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
WS 407 *cont.*		50	7·09	33·92	26·58	8·05	105							
		60	7·09	33·93	26·58	7·98	107							
		80	7·09	33·93	26·58	8·02	105							
		100	7·10	33·92	26·58	8·03	111							
WS 408	16	0	7·13	34·03	26·66	8·12	94	—	**N 50 V**	100–0	0920	—	—	A 3 iv 29
		10	7·12	34·06	26·68	8·12	93	—	**N 70 V**	50–0				
		20	7·12	34·06	26·68	8·11	97	—	,,	100–50				
		30	7·09	34·07	26·70	8·11	101	—	,,	250–100				
		40	7·09	34·06	26·69	8·13	99	—	,,	400–250	—	1023		
		50	7·09	34·06	26·69	8·13	96	—	**N 100 B**	112–0	1100	1120	$\frac{2}{3}$	KT
		60	7·06	34·06	26·69	8·12	102	—	**N 70 B**					
		80	6·72	34·09	26·76	8·12	101							
		100	6·12	34·10	26·84	8·04	113							
		150	5·53	34·14	26·96	8·02	117							
		200	5·23	34·14	26·99	7·96	117							
		300	4·67	34·18	27·09	7·92	125							
		400	4·42	34·18	27·11	7·94	128							
WS 409	16	0	8·00	34·05	26·55	8·15	98	—	**N 50 V**	100–0	**2017**	—	—	A 3 iv 29
		10	8·00	34·06	26·56	8·09	103	—	**N 70 V**	50–0	—	—	—	considerable stray on wire
		20	8·00	34·05	26·55	8·09	105	—	,,	100–50				
		30	8·00	34·06	26·56	8·09	102	—	,,	250–100				
		40	7·98	34·05	26·56	8·09	105	—	,,	500–250	—	**2120**		
		50	7·44	34·05	26·63	8·08	113	—	**N 100 B**	106–0	**2206**	**2226**	$\frac{2}{3}$	KT
		60	6·37	34·08	26·80	8·01	124	—	**N 70 B**					
		80	6·03	34·12	26·88	8·01	130							
		100	5·81	34·12	26·90	8·02	130							
		150	5·16	34·13	26·98	7·98	136							
		200	4·92	34·13	27·01	7·97	137							
		300	4·59	34·14	27·07	7·97	131							
		400	4·30	34·14	27·10	7·97	131							
WS 410	2	—	—	—	—	—	—	—	**N 100 B** **N 70 B**	78–0	**2046**	**2106**	$\frac{2}{3}$	KT
WS 411	3	—	—	—	—	—	—	—	**N 100 B** **N 70 B**	100–0	0817	0837	$\frac{2}{3}$	KT
WS 412	3	—	—	—	—	—	—	—	**N 100 B** **N 70 B**	100–0	**1900**	**1920**	$\frac{2}{3}$	KT
WS 413	4	—	—	—	—	—	—	—	**N 100 B** **N 70 B**	97–0	1305	1325	$\frac{2}{3}$	KT
WS 414	5	—	—	—	—	—	—	—	**N 100 B** **N 70 B**	105–0	**0537**	0557	$\frac{2}{3}$	KT
WS 415	5	—	—	—	—	—	—	—	**N 100 B** **N 70 B**	103–0	1750	1810	$\frac{2}{3}$	KT
WS 416	6	—	—	—	—	—	—	—	**N 100 B** **N 70 B**	107–0	1651	1711	$\frac{2}{3}$	KT
WS 417	1	0	2·42	33·77	26·97	—	—	—	**N 50 V**	100–0	**1955**			
		10	2·42	33·77	26·97	—	—	—	**N 70 V**	50–0				
		20	2·42	33·76	26·97	—	—	—	,,	100–50				
		30	2·42	33·76	26·97	—	—	—	,,	180–100	—	**2045**		
		40	2·42	33·78	26·99	—	—	—	**N 100 B**	85–0	**2119**	**2139**	$\frac{2}{3}$	KT
		50	2·42	33·76	26·97	—	—	—	**N 70 B**					
		60	2·42	33·76	26·97									
		80	2·42	33·77	26·97									

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 417 *cont.*	54° 53′ 40″ S, 36° 23′ 10″ W	1929 10 iv										
WS 418	55° 02′ 30″ S, 36° 31′ 00″ W	10–11 iv	2312	227 gy. M. sm. P.	NW	3	NW	1	b. c. vis. 3–4	1014·4	0·6	
WS 419	55° 12′ 00″ S, 36° 38′ 00″ W	11 iv	0304	2475 gy. M.	NNW	3	NNW	2	b. c. vis. 2	1011·8	1·4	
WS 420	54° 23′ 00″ S, 37° 40′ 00″ W	14 iv	0955	64 h.	SW	3	SW	4	c. vis. 6	993·1	0·6	mod. SW swell
WS 421	54° 25′ 30″ S, 37° 57′ 30″ W	14 iv	1205	185 gn. M. sm. St.	SW	3	SW	4	c. vis. 6	993·1	0·6	mod. SW swell
WS 422	54° 27′ 50″ S, 38° 16′ 10″ W	14 iv	1450	187	SW	3	SW	3	o. vis. 6	992·7	0·6	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME From	TIME To	Length of tow (miles)	
WS 417 *cont.*		100	1·38	33·85	27·11									
		150	0·89	34·05	27·31									
		180	1·23	34·20	27·40									
WS 418	1–2	0	2·36	33·78	26·99	—	—	—	**N 50 V**	100–0	**2320**			
		10	2·33	33·78	26·99	—	—	—	**N 70 V**	50–0				
		20	2·33	33·78	26·99	—	—	—	„	100–50				
		30	2·32	33·78	26·99	—	—	—	„	200–100	—	**2355**		
		40	2·32	33·78	26·99	—	—	—	**N 70 B**	100–0	**0029**	**0050**	$\frac{2}{3}$	KT
		50	2·32	33·77	26·97	—	—	—	**N 100 B**	92–0	**0107**	**0127**	$\frac{2}{3}$	KT
		60	2·32	33·78	26·99									
		80	2·32	33·77	26·97									
		90	1·00	33·85	27·14									
		100	0·50	33·93	27·23									
		150	0·72	34·09	27·35									
		200	1·25	34·23	27·43									
WS 419	2	0	2·20	33·75	26·97	—	—	—	**N 50 V**	100–0	**0310**			
		10	2·20	33·76	26·98	—	—	—	**N 70 V**	50–0				
		20	2·21	33·76	26·98	—	—	—	„	100–50				
		30	2·22	33·76	26·98	—	—	—	„	250–100				
		40	2·22	33·75	26·97	—	—	—	„	500–250				
		50	2·22	33·75	26·97	—	—	—	„	750–500				
		60	2·22	33·77	26·98	—	—	—	„	1000–750	—	**0515**		
		80	2·22	33·76	26·98	—	—	—	**N 100 B**	95–0	**0637**	0658	$\frac{2}{3}$	KT
		90	0·55	33·77	27·10	—	—	—	**N 70 B**					
		100	0·30	33·90	27·22									
		150	0·70	34·07	27·34									
		200	1·25	34·22	27·41									
		300	1·86	34·39	27·52									
		400	2·00	34·45	27·55									
		600	2·06	34·54	27·63									
		800	2·04	34·58	27·66									
		1000	1·95	34·60	27·67									
		1500	1·66	34·63	27·72									
		2000	1·16											
WS 420	5	0	2·14	33·74	26·97	—	—	—	**N 50 V**	50–0	1000			
		10	2·12	33·72	26·96	—	—	—	**N 70 V**	50–0	—	1020		
		20	2·12	33·73	26·96	—	—	—	**N 100 B**	86–0	1048	1058	$\frac{1}{3}$	KT
		30	2·12	33·74	26·97	—	—	—	**N 70 B**					
		40	2·12	33·74	26·97									
		50	2·12	33·73	26·96									
		60	2·10	33·73	26·96									
WS 421	5	0	2·10	33·73	26·96	—	—	—	**N 50 V**	100–0	1207			
		10	2·12	33·74	26·96	—	—	—	**N 70 V**	50–0				
		20	2·12	33·73	26·97	—	—	—	„	100–50				
		30	2·12	33·73	26·96	—	—	—	„	150–100	—	1250		
		40	2·12	33·74	26·97	—	—	—	**N 100 B**	120–0	1304	1324	$\frac{2}{3}$	KT
		50	2·12	33·74	26·97	—	—	—	**N 70 B**					
		60	2·12	33·74	26·97									
		80	2·12	33·73	26·96									
		100	2·12	33·74	26·97									
		150	0·83	33·93	27·21									
WS 422	5	0	2·10	33·72	26·96	—	—	—	**N 50 V**	100–0	1455			
		10	2·10	33·72	26·96	—	—	—	**N 70 V**	50–0				
		20	2·10	33·73	26·96	—	—	—	„	100–50				
		30	2·10	33·73	26·96	—	—	—	„	150–100	—	1530		
		40	2·10	33·73	26·96	—	—	—	**N 100 B**	113–0	1559	1619	$\frac{2}{3}$	KT
		50	2·10	33·74	26·97	—	—	—	**N 70 B**					

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 422 *cont.*	54° 27′ 50″ S, 38° 16′ 10″ W	1929 14 iv										
WS 423	54° 31′ 30″ S, 38° 32′ 00″ W	14 iv	1740	226 gn. M.	WSW	3	WSW	3	o. vis. 2	992·6	0·6	
WS 424	54° 34′ 00″ S, 38° 49′ 00″ W	14 iv	2205	227 gn. M.	W × S	3	W × S	2	o. vis. 1	992·0	0·3	
WS 425	54° 37′ 10″ S, 39° 07′ 30″ W	15 iv	0238	229 bl. G.	WSW	4	WSW	4	o. vis. 10	992·3	0·0	
WS 426	54° 38′ 35″ S, 39° 22′ 00″ W	15 iv	0632	2433 c. G.	WSW	4	WSW	3	o. vis. 6	993·8	0·6	
WS 427	53° 34′ 00″ S, 40° 10′ 00″ W	28–29 iv	2130	232 h.	SW	4	SW	4	o. c. vis. 2	1000·3	0·9	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.³	O_2 cc. p. l.	Gear	Depth (metres)	TIME From	TIME To	Length of tow (miles)	
WS 422 *cont.*		60	2·10	33·73	26·96									
		80	2·10	33·73	26·96									
		100	1·90	33·74	26·97									
		150	0·45	33·98	27·28									
WS 423	5	0	2·14	33·76	26·99	—	—	—	**N 50 V**	100–0	**1742**			
		10	2·16	33·75	26·98	—	—	—	**N 70 V**	50–0				
		20	2·16	33·75	26·98	—	—	—	,,	100–50				
		30	2·16	33·75	26·98	—	—	—	,,	200–100	—	**1820**		
		40	2·16	33·75	26·98	—	—	—	**N 100 B**	100–0	**1945**	**2005**	⅔	
		50	2·16	33·76	26·99	—	—	—	**N 70 B**					
		60	2·16	33·75	26·98									
		80	2·15	33·75	26·98									
		100	2·12	33·77	26·99									
		150	0·68	33·96	27·25									
		200	0·84	34·11	27·36									
WS 424	5	0	2·03	33·77	26·99	—	—	—	**N 50 V**	100–0	**2210**			
		10	2·08	33·76	26·99	—	—	—	**N 70 V**	50–0				
		20	2·08	33·78	27·01	—	—	—	,,	100–50				
		30	2·08	33·78	27·01	—	—	—	,,	200–100	—	**2255**		
		40	2·08	33·77	26·99	—	—	—	**N 100 B**	95–0	**2333**	**2353**	⅔	KT
		50	2·08	33·76	26·99	—	—	—	**N 70 B**					
		60	2·08	33·76	26·99									
		80	2·08	33·77	26·99									
		100	1·52	33·79	27·06									
		150	0·54	34·02	27·31									
		200	1·00	34·14	27·38									
WS 425	6	0	2·69	33·89	27·04	—	—	—	**N 50 V**	100–0	**0242**			
		10	2·74	33·87	27·03	—	—	—	**N 70 V**	50–0				
		20	2·73	33·87	27·03	—	—	—	,,	100–50				
		30	2·74	33·88	27·04	—	—	—	,,	200–100	—	**0330**		
		40	2·74	33·87	27·03	—	—	—	**N 100 B**	118–0	**0353**	**0413**	⅔	KT
		50	2·74	33·90	27·05	—	—	—	**N 70 B**					
		60	2·74	33·88	27·04									
		80	2·74	33·90	27·05									
		100	2·51	33·90	27·07									
		150	0·50	34·00	27·29									
		200	—	34·23										
WS 426	6	0	2·30	33·87	27·07	—	—	—	**N 50 V**	100–0	**0635**			
		10	2·30	33·87	27·07	—	—	—	**N 70 V**	50–0				
		20	2·30	33·87	27·07	—	—	—	,,	100–50				
		30	2·30	33·87	27·07	—	—	—	,,	250–100				
		40	2·30	33·87	27·07	—	—	—	,,	500–250				
		50	2·30	33·87	27·07	—	—	—	,,	750–500				
		60	2·30	33·88	27·08	—	—	—	,,	1000–750	—	0840		
		80	2·27	33·88	27·08	—	—	—	**N 100 B**	140–0	1013	1033	⅔	KT
		100	2·26	33·89	27·08	—	—	—	**N 70 B**					
		150	2·20	34·08	27·24									
		200	1·77	34·17	27·35									
		300	1·40	34·18	27·38									
		400	2·02	34·37	27·49									
		600	2·11	34·39	27·50									
		800	2·14	34·57	27·64									
		1000	2·07	34·57	27·64									
		1500	1·62	—	—	—	—	—	—	—	—	—	—	bottle touched bottom
WS 427	18–19	0	1·94	33·79	27·03	—	—	—	**N 50 V**	100–0	**2155**			
		10	1·94	33·79	27·03	—	—	—	**N 70 V**	50–0				
		20	1·93	33·79	27·03	—	—	—	,,	100–50				

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 427 *cont.*	53° 34′ 00″ S, 40° 10′ 00″ W	1929 28–29 iv										
WS 428	53° 07′ 00″ S, 42° 30′ 00″ W	29 iv	1400	1966 gy. M. f. G.	W	2	W	2	o. m. r. f. vis. 2–3	994·8	4·4	
WS 429	53° 02′ 30″ S, 45° 28′ 00″ W	30 iv	0750	2549 gy. M.	WSW	2	WSW	1	o. m. vis. 5	1001·4	2·2	
WS 430	52° 40′ 00″ S, 48° 09′ 00″ W	30 iv–1 v	2325	3425	S	3	S	2	o. vis. 4	1008·6	4·3	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
WS 427 *cont.*		30	1·93	33·79	27·03	—	—	—	**N 70 V**	200–100	—	**2248**		
		40	1·90	33·79	27·04	—	—	—	**N 100 B**	140–0	**0050**	**0112**	⅔	KT
		50	1·90	33·79	27·04	—	—	—	**N 70 B**					
		60	1·88	33·80	27·04									
		80	1·88	33·80	27·04									
		100	1·80	33·82	27·06									
		150	0·52	34·04	27·32									
		200	1·74	34·25	27·47									
WS 428	19	0	2·62	33·93	27·08	—	—	—	**N 50 V**	100–0	1410			
		10	2·61	33·94	27·09	—	—	—	**N 70 V**	50–0				
		20	2·59	33·94	27·09	—	—	—	,,	100–50				
		30	2·59	33·94	27·09	—	—	—	,,	250–100				
		40	2·59	33·94	27·09	—	—	—	,,	500–250				
		50	2·59	33·94	27·09	—	—	—	,,	750–500				
		60	2·59	33·94	27·09	—	—	—	,,	1000–750	—	1617		
		80	2·59	33·93	27·08	—	—	—	**N 100 B**	140–0	**1808**	**1828**	⅔	KT
		100	2·59	33·93	27·08	—	—	—	**N 70 B**					
		150	1·95	34·15	27·32									
		200	1·74	34·23	27·40									
		300	1·82	34·32	27·46									
		400	1·90	34·43	27·55									
		600	2·05	34·53	27·62									
		800	2·06	34·58	27·65									
		1000	2·00	34·60	27·67									
		1500	1·65	34·67	27·75									
WS 429	20	0	2·91	33·90	27·04	—	—	—	**N 50 V**	100–0	0756			
		10	2·94	33·88	27·02	—	—	—	**N 70 V**	50–0				
		20	2·95	33·89	27·02	—	—	—	,,	100–50				
		30	2·96	33·89	27·02	—	—	—	,,	250–100				
		40	2·99	33·90	27·03	—	—	—	,,	500–250				
		50	3·01	33·90	27·03	—	—	—	,,	750–500				
		60	3·05	33·90	27·02	—	—	—	,,	1000–750	—	0955		
		80	3·05	33·93	27·04	—	—	—	**N 100 B**	86–0	1149	1210	⅔	KT
		100	2·16	34·07	27·24	—	—	—	**N 70 B**					
		150	1·22	34·09	27·31									
		200	1·18	34·21	27·42									
		300	2·10	34·33	27·44									
		400	2·05	34·42	27·52									
		600	2·09	34·52	27·60									
		800	2·04	34·62	27·70									
		1000	1·87	34·68	27·75									
		1500	1·61	34·69	27·77									
		2000	1·43	34·70	27·80									
WS 430	20–21	0	3·77	33·98	27·02	—	—	—	**N 50 V**	100–0	**2330**			
		10	3·77	33·99	27·03	—	—	—	**N 70 V**	50–0				
		20	3·77	33·99	27·03	—	—	—	,,	100–50				
		30	3·79	33·99	27·03	—	—	—	,,	250–100				
		40	3·79	33·98	27·02	—	—	—	,,	500–250				
		50	3·79	33·98	27·02	—	—	—	,,	750–500				
		60	3·79	34·00	27·03	—	—	—	,,	1000–750	—	**0151**		
		80	3·54	34·04	27·09	—	—	—	**N 100 B**	128–0	**0417**	**0437**	⅔	KT
		100	2·86	34·10	27·20	—	—	—	**N 70 B**					
		150	2·66	34·12	27·24									
		200	2·54	34·12	27·25									
		300	2·39	34·13	27·26									
		400	2·12	34·23	27·37									
		600	2·27	34·44	27·53									
		800	2·26	34·46	27·54									
		1000	2·17	34·56	27·63									

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
WS 430 *cont.*	52° 40′ 00″ S, 48° 09′ 00″ W	1929 30 iv– 1 v										
WS 431	52° 18′ 00″ S, 50° 59′ 00″ W	1 v	1620	3411 f. lt. y. & bl. S.	W	3	SW	3	o. m. vis. 2–3	1020·5	5·4	
WS 432	51° 56′ 30″ S, 53° 28′ 00″ W	2 v	0845	2432 d. S.	NW	5	NW	5	b. c. vis. 7	1016·0	7·5	
WS 433	51° 44′ 00″ S, 56° 23′ 00″ W	5–6 v	2100	1035 f. gy. S.	SW	4	SW	4	b. c. s. r.	997·8	4·4	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME From	TIME To	Length of tow (miles)	
WS 430 *cont.*		1500	2·01	34·66	27·72									
		2000	1·64	34·70	27·78									
		3000	0·82	34·67	27·81									
WS 431	21	0	5·69	34·07	26·88	—	—	—	**N 50 V**	100–0	1623			
		10	5·69	34·06	26·87	—	—	—	**N 70 V**	50–0				
		20	5·69	34·08	26·89	—	—	—	,,	100–50				
		30	5·69	34·08	26·89	—	—	—	,,	250–100				
		40	5·69	34·06	26·87	—	—	—	,,	500–250				
		50	5·69	34·07	26·88	—	—	—	,,	750–500				
		60	5·69	34·08	26·89	—	—	—	,,	1000–750	—	**1845**		
		80	5·34	34·06	26·91	—	—	—	**N 100 B**	95–0	**2032**	**2052**	⅔	KT
		100	4·82	34·05	26·96	—	—	—	**N 70 B**					
		150	4·24	34·15	27·11									
		200	3·77	34·15	27·16									
		300	3·09	34·16	27·23									
		400	2·62	34·17	27·28									
		600	2·18	34·24	27·38									
		800	2·30	34·36	27·46									
		1000	2·30	34·47	27·54									
		1500	2·18	34·60	27·65									
		2000	2·12	34·63	27·69									
		3000	1·60	34·68	27·77									
WS 432	22	0	5·55	34·05	26·87	—	—	—	**N 50 V**	100–0	0850			
		10	5·55	34·05	26·87	—	—	—	**N 70 V**	50–0				
		20	5·55	34·05	26·87	—	—	—	,,	100–50				
		30	5·56	34·05	26·87	—	—	—	,,	250–100				
		40	5·47	34·05	26·88	—	—	—	,,	500–250				
		50	5·39	34·05	26·89	—	—	—	,,	750–500				
		60	5·31	34·05	26·90	—	—	—	,,	1000–750	—	1104		
		80	5·07	34·05	26·93	—	—	—	**N 100 B**	180–0	1236	1256	⅔	KT
		100	4·84	34·06	26·97	—	—	—	**N 70 B**					
		150	4·48	34·15	27·09									
		200	4·21	34·15	27·12									
		300	3·90	34·15	27·15									
		400	3·59	34·15	27·18									
		600	3·33	34·19	27·24									
		800	2·87	34·24	27·32									
		1000	2·58	34·34	27·42									
		1500	2·39	34·47	27·53									
		2000	2·15	34·62	27·69									
WS 433	26–27	0	5·88	34·05	26·83	—	—	—	**N 50 V**	100–0	**2105**			
		10	5·84	34·05	26·84	—	—	—	**N 70 V**	50–0				
		20	5·82	34·05	26·84	—	—	—	,,	100–50				
		30	5·85	34·06	26·85	—	—	—	,,	250–100				
		40	5·84	34·06	26·85	—	—	—	,,	500–250				
		50	5·84	34·05	26·84	—	—	—	,,	750–500				
		60	5·85	34·06	26·85	—	—	—	,,	1000–750	—	**2340**		
		80	5·84	34·06	26·85	—	—	—	**N 100 B**	86–0	**0026**	**0046**	⅔	KT
		100	5·79	34·07	26·87	—	—	—	**N 70 B**					
		150	5·66	34·15	26·95									
		200	4·81	34·17	27·06									
		300	4·41	34·16	27·09									
		400	4·18	34·16	27·12									
		600	3·68	34·15	27·17									
		800	3·28	34·23	27·27									

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
SS 1	55° 35′ 00″ S, 30° 30′ 00″ W	1927 18 xi	1800	—	S × E	2–3	S × E	2	o.	1000	− 1·3	slight swell
SS 2	55° 36′ 00″ S, 30° 33′ 00″ W	20 xi	1100	—	NW × N	1–3	NW × N	1–2	b. c.	1005	− 2·6	slight swell
SS 3	54° 02′ 00″ S, 31° 22′ 00″ W	24 xi	1025	—	S × W	3	S × W	3	o. c.	1016	− 0·5	slight NE swell
SS 4	54° 03′ 00″ S, 31° 38′ 00″ W	25 xi	2130	—	S × W	1–2	S × W	1–2	b. c.	1026	− 0·7	slight NE swell
SS 5	54° 02′ 00″ S, 31° 40′ 00″ W	25 xi	2245	—	S × W	0–1	S × W	0–1	c.	1026	− 1·1	slight NE swell
SS 6	54° 20′ 00″ S, 29° 31′ 00″ W	29 xi	2200	—	SW×W	0–1	SW×W	0–1	c. f. s.	1010	− 0·4	slight N swell
SS 7	54° 19′ 20″ S, 29° 32′ 40″ W	29 xi	2245	—	SW×W	0–1	SW×W	0–1	f. s.	1009	− 0·8	slight N swell
SS 8	54° 20′ 00″ S, 29° 31′ 00″ W	30 xi	1400 2000	— —	NW × N —	2 —	NW × N —	2 —	o. f. s. —	— 1002·3	— 0·2	slight N swell
SS 9	54° 31′ 00″ S, 29° 40′ 00″ W	2 xii	1830	—	NE × E	1–2	NE × E	1–2	f.	1004	0·6	slight NE swell
SS 10	54° 30′ 20″ S, 29° 38′ 45″ W	2 xii	1925	—	NE × N	2	NE × N	2	f.	1003	0·6	slight NE swell
SS 11	54° 31′ 00″ S, 29° 48′ 00″ W	6 xii	2100	—	SW×W	3	SW×W	2	c.	998	− 1·5	
SS 12	54° 30′ 20″ S, 29° 50′ 20″ W	6 xii	2145	—	SW×W	3	SW×W	2	c.	998	− 1·6	
SS 13	54° 22′ 00″ S, 30° 00′ 00″ W	8 xii	1030 1200 1600	— — —	SW×W — NW×W	3 — 3	SW×W — NW×W	3 — 3	c. — c.	— 1010 —	— 0·4 0·0	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p. l.	Gear	Depth (metres)	TIME From	TIME To	Length of tow (miles)	
SS 1	24	0	−1·9	34·16	27·52	—	—	—	**N 100 B** **N 70 B**	83–0	1807	1825	$\frac{2}{3}$	KT
SS 2	26	—	—	—	—	—	—	—	**N 70 V**	50–0	1120			
									,,	100–(0)				
									,,	250–(0)	—	1225		
SS 3	0	40	−1·2	34·04	27·40	—	—	—	**N 50 V**	100–0	1340			
		50	−1·2	34·05	27·41	—	—	—	**N 70 V**	50–0				
		60	−1·2	34·05	27·41	—	—	—	,,	100–50				
		80	−1·2	34·05	27·41	—	—	—	,,	250–100	—	1515		
		100	−1·2	34·05	27·41									
		125	−0·55	34·33	27·60									
		150	−0·2	34·45	27·69									
		200	0·35	34·51	27·71									
SS 4	1	0	−0·7	34·15	27·49	—	—	—	**N 100 B** **N 70 B**	102–0	**2155**	**2215**	$\frac{2}{3}$	KT
SS 5	1	0	−1·0	34·20	27·52	—	—	—	**N 100 B** **N 70 B**	98–0	**2250**	**2310**	$\frac{2}{3}$	KT
SS 6	5	0	−0·5	34·05	27·38	—	—	—	**N 100 B** **N 70 B**	137–0	**2209**	**2228**	$\frac{2}{3}$	KT
SS 7	5	0	−0·5	34·13	27·44	—	—	—	**N 100 B** **N 70 B**	150–0	**2252**	**2311**	$\frac{2}{3}$	KT
SS 8	6	0	−0·9	33·96	27·33	—	—	—	**N 50 V**	100–0	1400			
		5	−0·9	33·96	27·33	—	—	—	**N 70 V**	50–0				
		10	−0·9	33·97	27·34	—	—	—	,,	100–50				
		20	−0·9	33·93	27·30	—	—	—	,,	250–100	—	1627		
		30	−1·1	33·95	27·32									
		40	−1·2	33·95	27·34									
		50	−1·2	33·96	27·34									
		60	−1·3	34·02	27·39									
		100	−1·1	34·11	27·45									
		125	−0·5	34·33	27·60									
		150	0·0	34·38	27·63									
SS 9	8	0	−0·9	33·87	27·26	—	—	—	**N 100 B** **N 70 B**	59–0	1847	1903	$\frac{1}{2}$	KT
SS 10	8	0	−0·85	33·96	27·32	—	—	—	**N 100 B** **N 70 B**	101–0	1929	1947	$\frac{2}{3}$	KT
SS 11	13	0	−0·8	34·03	27·38	—	—	—	**N 100 B** **N 70 B**	84–0	**2107**	**2124**	$\frac{3}{5}$	KT
SS 12	13	0	−0·9	33·95	27·32	—	—	—	**N 100 B** **N 70 B**	123–0	**2152**	**2212**	$\frac{2}{3}$	KT
SS 13	14	0	−0·85	33·98	27·34	—	—	—	**N 50 V**	100–0	1100			
		10	−0·85	33·98	27·34	—	—	—	**N 70 V**	50–0				
		30	−0·9	33·98	27·35	—	—	—	,,	100–50				
		50	−0·95	33·97	27·34	—	—	—	,,	250–100	—	1405		
		60	−0·95	33·97	27·34									
		80	−1·0	34·05	27·40									
		100	−1·1	34·16	27·49									
		125	−0·55	34·31	27·59									
		175	0·2	34·45	27·67									
		200	0·45	34·52	27·71									

South Sandwich Islands

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
SS 14	54° 30′ 00″ S, 30° 11′ 00″ W	1927 11 xii	1830	—	N × E	2	N × E	2	f. r.	1004	1·4	slight N × E swell
SS 15	54° 22′ 00″ S, 30° 11′ 00″ W	11 xii	2300	—	NE × N	3–4	NE × N	3–4	o.	1001	1·2	slight N × W swell
SS 16	55° 00′ 00″ S, 27° 29′ 00″ W	14 xii	2115	—	W × N	3	W × N	3	o.	1009	– 1·0	mod. NW swell
SS 17	55° 00′ 00″ S, 27° 43′ 00″ W	14 xii	2300	—	NW×W	3	NW×W	3	o. s.	1008	– 0·7	mod. NW swell
SS 18	54° 58′ 00″ S, 27° 32′ 00″ W	15 xii	0940	—	NW×W	2	NW×W	2	c. s.	1006	0·7	slight N swell
SS 19	54° 51′ 30″ S, 27° 38′ 00″ W	19 xii	0700	—	NW	4–5	NW	4–5	o. f.	1008	1·0	mod. N swell
SS 20	54° 52′ 30″ S, 27° 36′ 30″ W	19 xii	0825	—	NW	5	NW	5	o. f.	1006	1·3	slight N swell
SS 21	56° 12′ 00″ S, 25° 40′ 00″ W	21 xii	1315 2000	— —	E × N E × N	2 4	E × N E × N	2 3	c. f. s.	1007 —	3·0 – 1·0	slight NE swell
SS 22	55° 56′ 00″ S, 25° 56′ 00″ W	22 xii	2000	—	SE × E	2	SE × E	2	b.	1014	– 0·4	slight NE swell
SS 23	55° 59′ 00″ S, 25° 56′ 00″ W	22 xii	2120	—	SE × E	2	SE × E	2	b.	1014	– 0·7	slight NE swell
SS 24	56° 49′ 00″ S, 25° 35′ 00″ W	24 xii	0945	—	NE	2	NE	2	c.	1007	1·0	slight NE swell
SS 25	56° 47′ 50″ S, 25° 33′ 00″ W	24 xii	1045	—	NE	2	NE	2	c.	1007	1·5	slight NE swell
SS 26	60° 14′ 00″ S, 26° 27′ 00″ W	1928 4 i	1730	—	W × S	1–2	W × S	1–2	f.	1008	0·4	slight SW swell
SS 27	60° 15′ 00″ S, 26° 33′ 00″ W	4 i	1850	—	NW×W	1–2	NW×W	1–2	o. f. e.	1008	– 0·6	slight SW swell

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
SS 14	17	0	– 0·5	33·88	27·25	—	—	—	**N 100 B** **N 70 B**	55–0	1841	1901	$\frac{2}{3}$	KT
SS 15	17	0	– 0·5	33·96	27·31	—	—	—	**N 100 B** **N 70 B**	104–0	**2318**	**2340**	$\frac{2}{3}$	KT
SS 16	20	0	– 0·6	33·78	27·17	—	—	—	**N 100 B** **N 70 B**	104–0	**2132**	**2150**	$\frac{2}{3}$	KT
SS 17	20	0	– 0·65	33·83	27·22	—	—	—	**N 100 B** **N 70 B**	99–0	**2311**	**2329**	$\frac{2}{3}$	KT
SS 18	21	20	– 0·75	33·78	27·18	—	—	—	**N 50 V**	100–0	0950			
		30	– 0·8	33·78	27·18	—	—	—	**N 70 V**	50–0				
		40	– 0·95	33·78	27·19	—	—	—	,,	100–50				
		60	– 1·2	33·82	27·23	—	—	—	,,	250–100	—	1100		
		80	– 1·2	33·93	27·31									
		100	– 1·3	34·07	27·43									
		125	– 1·0	34·29	27·59									
		150	– 0·55	34·38	27·65									
		175	0·1	34·49	27·70									
		200	0·4	34·56	27·75									
		250	0·85	34·60	27·75									
SS 19	25	0	0·05	33·86	27·20	—	—	—	**N 100 B** **N 70 B**	141–0	0723	0742	$\frac{2}{3}$	KT
SS 20	25	0	0·15	33·87	27·21	—	—	—	**N 100 B** **N 70 B**	119–0	0834	0851	$\frac{2}{3}$	KT
SS 21	27	0	– 0·35	33·52	26·95	—	—	—	**N 50 V**	100–0	1635			
		5	– 0·36	33·51	26·94	—	—	—	**N 70 V**	50–0				
		10	– 0·6	33·53	26·96	—	—	—	,,	100–50				
		20	– 0·65	33·53	26·97	—	—	—	,,	250–100	—	2000		
		30	– 0·7	33·62	27·05									
		40	– 0·75	33·69	27·10									
		50	– 1·1	33·79	27·20									
		60	– 1·35	33·91	27·30									
		80	– 1·3	34·07	27·43									
		100	– 1·4	34·14	27·49									
		150	– 1·25	34·23	27·56									
		200	– 0·25	34·49	27·72									
		250	0·0	34·58	27·79									
SS 22	28	0	– 0·5	33·31	26·79	—	—	—	**N 100 B** **N 70 B**	95–0	**2031**	**2049**	$\frac{3}{5}$	KT
SS 23	28	0	– 0·6	33·28	26·76	—	—	—	**N 100 B** **N 70 B**	124–0	**2123**	**2142**	$\frac{2}{3}$	KT
SS 24	0	0	– 0·7	—	—	—	—	—	**N 100 B** **N 70 B**	81–0	1005	1023	$\frac{3}{5}$	KT
SS 25	0	0	– 0·65	33·51	26·96	—	—	—	**N 100 B** **N 70 B**	62–0	1056	1115	$\frac{2}{3}$	KT
SS 26	12	0	– 1·6	33·62	27·08	—	—	—	**N 100 B** **N 70 B**	79–0	1740	1757	$\frac{3}{5}$	KT
SS 27	12	0	– 1·1	33·87	27·26	—	—	—	**N 100 B** **N 70 B**	104–0	1855	1912	$\frac{3}{5}$	KT

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
SS 28	59° 26′ 00″ S, 25° 24′ 00″ W	1928 11 i	1900	—	W × N	4–5	W × N	4–5	o.	1000	– 0·4	
SS 29	60° 05′ 30″ S, 24° 19′ 00″ W	13 i	0950	—	N × W	3	N × W	3	o. f.	998	0·5	slight SW swell
SS 30	60° 08′ 30″ S, 24° 19′ 00″ W	13 i	1115	—	N × W	3	N × W	3	e. f.	999	0·6	slight SW swell
SS 31	60° 59′ 00″ S, 25° 55′ 30″ W	18 i	1200	—	SW×W	2–3	SW×W	2–3	c.	997	1·1	slight NE swell
SS 32	60° 57′ 00″ S, 25° 57′ 30″ W	18 i	1420	—	SW×W	3	SW×W	3	c.	998	1·0	mod. NE swell
SS 33	60° 52′ 00″ S, 25° 29′ 00″ W	20 i	1600	—	S × W	4	S × W	4	c.	996	0·3	
SS 34	60° 51′ 00″ S, 26° 25′ 00″ W	21 i	1900	—	S × W	2	S × W	2	c.	1007	– 0·2	
SS 35	60° 49′ 00″ S, 26° 32′ 00″ W	21 i	2025	—	S × W	2–3	S × W	2–3	b.	1007	– 0·5	slight NE swell
SS 36	60° 58′ 00″ S, 26° 20′ 00″ W	24 i	1030	—	NE × E	1–2	NE × E	1–2	o.	1014	1·3	
SS 37	61° 00′ 20″ S, 26° 26′ 00″ W	24 i	1200	—	NE × E	2	NE × E	2	o.	1013	2·2	
SS 38	61° 05′ 00″ S, 26° 20′ 00″ W	27 i	1110	—	S × W	5	S × W	5	c.	1004	– 1·5	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.³	O_2 cc. p. l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
SS 28	18	30	– 0·2	33·71	27·10	—	—	—	**N 50 V**	100-0	1900			
		40	– 0·5	33·80	27·18	—	—	—	**N 70 V**	50–0				
		50	– 1·4	33·95	27·33	—	—	—	,,	100–(0)				
		60	– 1·6	33·96	27·35	—	—	—	,,	250–(0)	—	**2300**		
		80	– 1·7	34·13	27·48									
		100	– 1·5	34·18	27·53									
		125	– 1·2	34·32	27·63									
		150	– 0·45	34·36	27·63									
		200	0·15	34·57	27·77									
		250	0·4	34·63	27·81									
SS 29	20	0	– 0·7	33·10	26·62	—	—	—	**N 100 B** **N 70 B**	97–0	1010	1031	$\frac{2}{3}$	KT
SS 30	20	0	– 0·35	33·24	26·72	—	—	—	**N 100 B** **N 70 B**	119–0	1122	1139	$\frac{3}{5}$	KT
SS 31	25	0	– 0·85	33·40	26·87	—	—	—	**N 100 B** **N 70 B**	135–0	1221	1240	$\frac{2}{3}$	KT
SS 32	25	0	– 0·5	33·35	26·82	—	—	—	**N 100 B** **N 70 B**	115–0	1440	1459	$\frac{2}{3}$	KT
SS 33	27	0	– 0·8	33·11	26·63	—	—	—	**N 50 V**	100–0	1945			
		5	– 0·8	33·16	26·68	—	—	—	**N 70 V**	50–0				
		10	– 0·75	33·16	26·68	—	—	—	,,	100–(0)				
		20	– 0·5	33·40	26·86	—	—	—	,,	250–100	—	**2100**		
		30	– 0·8	33·87	27·25									
		40	– 1·3	33·96	27·34									
		50	– 1·65	34·07	27·44									
		60	– 1·7	34·09	27·45									
		80	– 1·6	34·20	27·54									
		100	– 1·35	34·22	27·54									
		150	– 0·45	34·51	27·75									
		200	0·15	34·58	27·78									
		250	0·4	34·63	27·81									
SS 34	28	0	– 0·25	33·28	26·75	—	—	—	**N 100 B** **N 70 B**	141–0	1913	1931	$\frac{3}{5}$	KT
SS 35	28	0	– 0·65	33·23	26·74	—	—	—	**N 100 B** **N 70 B**	119–0	**2032**	**2051**	$\frac{2}{3}$	KT
SS 36	2	0	– 0·35	33·22	26·71	—	—	—	**N 100 B** **N 70 B**	128–0	1037	1055	$\frac{3}{5}$	KT
SS 37	2	0	– 0·7	33·31	26·80	—	—	—	**N 100 B** **N 70 B**	130–0	1204	1220	$\frac{1}{2}$	KT
SS 38	5	0	– 1·3	33·57	27·02	—	—	—	**N 50 V**	100–0	1110			
		5	– 1·3	33·57	27·02	—	—	—	**N 70 V**	50–0				
		10	– 1·25	33·55	27·01	—	—	—	,,	100–50				
		20	– 1·25	33·57	27·02	—	—	—	,,	250–100	—	1500		
		30	– 1·3	33·57	27·02									
		40	– 1·55	33·58	27·05									
		50	– 1·7	34·29	27·61									
		60	– 1·65	34·29	27·61									
		80	– 1·65	34·33	27·64									
		100	– 1·3	34·37	27·67									
		150	– 0·6	34·52	27·76									
		200	– 0·15	34·58	27·80									
		250	0·0	34·65	27·84									

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
SS 39	61° 14′ 00″ S, 26° 16′ 30″ W	1928 28 i	1130	—	N × E	2	N × E	2	c.	1003	– 1·0	
SS 40	61° 19′ 00″ S, 26° 06′ 00″ W	28 i	1300	—	N × E	2	N × E	2	c.	1004	—	
SS 41	61° 21′ 30″ S, 26° 25′ 00″ W	1 ii	1635	—	E × N	2–3	E × N	2–3	c.	997	1·0	
SS 42	61° 21′ 30″ S, 26° 20′ 30″ W	1 ii	1750	—	E × N	3–4	E × N	2–3	c. s.	996	– 0·5	
SS 43	61° 45′ 00″ S, 26° 50′ 00″ W	2 ii	1400	—	SE × E	3	SE × E	3	f. s.	992	0·0	
SS 44	62° 23′ 00″ S, 27° 04′ 00″ W	3 ii	1520	—	SE × S	3	SE × S	3	c. s.	995	0·6	
SS 45	62° 17′ 45″ S, 27° 15′ 45″ W	3 ii	1830	—	SE × S	3–4	SE × S	3	o.	996	– 0·8	
SS 46	62° 00′ 20″ S, 27° 05′ 00″ W	7 ii	1700	—	E × N	2	E × N	2	b.	1010	0·0	
SS 47	62° 13′ 00″ S, 27° 10′ 00″ W	7 ii	2020	—	SE × S	2	SE × S	2	b. c.	1005	– 1·0	
SS 48	62° 45′ 00″ S, 25° 42′ 00″ W	11 ii	1310	—	N × E	1	N × E	1	o. f.	981	1·4	slight N swell
SS 49	62° 21′ 30″ S, 24° 02′ 30″ W	12 ii	1440	—	SW×W	2	SW×W	2	o. f. e.	982	– 0·6	
SS 50	62° 19′ 20″ S, 24° 02′ 00″ W	12 ii	1540	—	W × S	3	W × S	3	o. s.	982	– 1·0	mod. NE swell
SS 51	62° 11′ 30″ S, 21° 30′ 00″ W	15 ii	1600	—	SW × S	3–4	SW × S	2	c.	991	– 2·2	slight NW swell
SS 52	62° 15′ 00″ S, 21° 36′ 20″ W	15 ii	1730	—	SSW	3	SSW	3	o.	989	– 2·8	mod. NW swell
SS 53	61° 30′ 00″ S, 23° 20′ 00″ W	16 ii	1315	—	SE × S	5	SE × S	3–4	o.	989	– 1·3	slight N swell

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc.p.l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
SS 39	6	0	−0·85	33·73	27·13	—	—	—	N 100 B N 70 B	70–0	1142	1201	2/3	KT
SS 40	6	0	−0·85	33·73	27·13	—	—	—	N 100 B N 70 B	97–0	1314	1333	2/3	KT
SS 41	10	0	−1·05	33·58	27·03	—	—	—	N 100 B N 70 B	137–0	1658	1719	2/3	KT
SS 42	10	0	−1·15	33·65	27·08	—	—	—	N 100 B N 70 B	119–0	1757	1813	1/2	KT
SS 43	11	40	−1·6	33·64	27·09	—	—	—	N 50 V	100–0	1420			
		50	−1·65	34·38	27·69	—	—	—	N 70 V	50–0				
		60	−1·65	34·40	27·70	—	—	—	,,	100–50				
		80	−1·63	34·41	27·71	—	—	—	,,	250–100	—	1510		
		100	−1·45	34·49	27·76									
		125	−0·85	34·58	27·82									
SS 44	12	0	−1·05	33·59	27·04	—	—	—	N 100 B N 70 B	110–0	1538	1558	2/3	KT
SS 45	12	0	−1·2	32·63	26·27	—	—	—	N 100 B N 70 B	99–0	1825	1842	3/5	KT
SS 46	15	0	−0·5	33·59	27·02	—	—	—	N 100 B N 70 B	119–0	1716	1734	3/5	KT
SS 47	15	0	−0·55	33·55	26·98	—	—	—	N 100 B N 70 B	141–0	**2038**	**2057**	2/3	KT
SS 48	19	—	—	—	—	—	—	—	N 50 V	100–0	1405			
									N 70 V	50–0				
									,,	100–50				
									,,	250–100	—	1520		
SS 49	20	0	−1·4	33·24	26·76	—	—	—	N 100 B N 70 B	141–0	1448	1506	3/5	KT
SS 50	20	0	−1·4	33·42	26·91	—	—	—	N 100 B N 70 B	95–0	1545	1604	2/3	KT
SS 51	23	0	−1·5	33·44	26·93	—	—	—	N 100 B N 70 B	110–0	1620	1638	3/5	KT
SS 52	23	0	−1·65	33·40	26·90	—	—	—	N 100 B N 70 B	146–0	1740	1800	2/3	KT
SS 53	25	10	−1·7	33·40	26·90	—	—	—	N 50 V	100–0	1315			
		20	−1·7	33·44	26·93	—	—	—	N 70 V	50–0				
		30	−1·55	34·33	27·64	—	—	—	,,	100–50				
		40	−1·63	34·36	27·67	—	—	—	,,	250–100	—	1430		
		50	−1·7	34·35	27·67									
		60	−1·75	34·42	27·71									
		80	−1·8	34·42	27·71									
		100	−1·8	34·40	27·70									
		125	−0·9	34·49	27·75									
		150	−0·6	34·60	27·83									
		175	−0·05	34·66	27·85									
		200	0·1	34·66	27·84									
		250	0·3	34·66	27·83									

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
SS 54	60° 59′ 20″ S, 23° 21′ 50″ W	1928 20 ii	2000	—	—	0–1	—	0–1	o. f. s.	995	− 0·3	
SS 55	61° 01′ 00″ S, 23° 30′ 00″ W	20 ii	2150	—	—	0–1	—	0–1	o. f. s.	995	− 0·5	
SS 56	61° 49′ 00″ S, 23° 54′ 00″ W	22 ii	1630	—	SW × S	3–1	SW × S	3–1	c.	1002	− 1·0	
SS 57	61° 49′ 30″ S, 23° 28′ 00″ W	23 ii	1740	—	—	0–1	—	0–1	o.	1005	− 0·6	slight SE swell
SS 58	61° 55′ 00″ S, 23° 40′ 00″ W	23 ii	1905	—	—	0–1	—	0–1	o.	1006	− 1·2	mod. SE swell

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
SS 54	29	0	−1·4	33·53	26·99	—	—	—	**N 100 B** **N 70 B**	95–0	**2002**	**2020**	$\frac{3}{5}$	KT
SS 55	29	0	−1·6	33·51	26·99	—	—	—	**N 100 B** **N 70 B**	155–0	**2201**	**2220**	$\frac{2}{3}$	KT
SS 56	1	0	−1·35	33·42	26·91	—	—	—	**N 50 V**	100–0	1907			
		5	−1·6	33·42	26·92	—	—	—	**N 70 V**	50–0				
		20	−1·6	33·42	26·92	—	—	—	,,	100–50				
		30	−1·7	33·84	27·25	—	—	—	,,	250-100	—	**2000**		
		40	−1·5	34·29	27·61									
		60	−1·7	34·36	27·67									
		80	−1·75	34·36	27·67									
		100	−1·4	34·45	27·73									
		125	−0·7	34·52	27·77									
		150	0·0	34·52	27·74									
		250	0·35	34·61	27·80									
SS 57	2	0	−1·5	33·42	26·92	—	—	—	**N 100 B** **N 70 B**	95–0	1746	1803	$\frac{3}{5}$	KT
SS 58	2	0	−1·45	33·44	26·92	—	—	—	**N 100 B** **N 70 B**	104–0	1913	**1931**	$\frac{3}{5}$	KT

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
RS 1	63° 33′ 00″ S, 168° 30′ 00″ E	1928 22 xi	1220	—	WNW	6	WNW	4	o.	997·0	− 2·5	station worked in open lead in pack ice
RS 2	63° 30′ 00″ S, 168° 50′ 00″ E	22 xi	2000	—	WNW	6	WNW	4	o.	997·0	− 2·5	station worked in open lead in pack ice
RS 3	63° 25′ 00″ S, 169° 50′ 00″ E	23 xi	1400	—	WNW	4	WNW	4	o.	1005·0	− 2·5	station worked in open lead in pack ice
RS 4	64° 15′ 00″ S, 171° 00′ 00″ E	26 xi	1330	1200	NW	4	NW	3	o.	971·9	− 3·0	lying in pack ice
RS 5	66° 35′ 00″ S, 177° 40′ 00″ E	4 xii	0930	—	NE	4	NE	2	—	993·6	− 1·5	station worked at edge of pack ice
RS 6	68° 11′ 00″ S, 179° 01′ 00″ W	10 xii	0930	—	WNW	5	WNW	5	c.	1012·5	− 1·0	
RS 7	68° 10′ 00″ S, 178° 00′ 00″ W	13 xii	0940	—	NW	4	NW	3	c. s.	988·8	− 1·0	
RS 8	69° 07′ 00″ S, 179° 39′ 00″ W	17 xii	—	—	SW	3	—	—	o.	967·5	− 2·0	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME From	TIME To	Length of tow (miles)	
RS 1	10	—	—	—	—	—	—	—	**N 100 B**	95–0	1240	1255	½	KT
RS 2	10	—	—	—	—	—	—	—	**N 100 B**	85–0	2000	2015	½	KT
RS 3	12	—	—	—	—	—	—	—	**N 100 B**	131–0	1417	1435	⅗	KT
RS 4	15	0	−1·60	34·00	27·38	—	—	—	**N 50 V**	100–0	1347	1348		
		5	−1·76	34·01	27·39									
		10	−1·80	34·08	27·45									
		20	−1·80	34·08	27·45									
		30	−1·75	34·18	27·53									
		40	−1·85	34·16	27·52									
		50	−1·85	34·18	27·54									
		60	−1·85	34·22	27·56									
		80	−0·20	34·29	27·56									
		100	0·55	34·57	27·75									
		150	1·18	34·61	27·75									
		200	1·18	34·63	27·76									
		300	1·25	34·66	27·77									
		400	1·20	34·67	27·79									
		500	1·07	34·66	27·79									
RS 5	22	0	−1·45	33·89	27·28	—	—	—	**N 50 V**	100–0	2014	2018		
		5	−1·50	33·89	27·29									
		10	−1·50	33·89	27·29									
		20	−1·60	33·89	27·29									
		30	−1·70	34·05	27·42									
		40	−1·75	34·14	27·50									
		50	−1·75	34·22	27·55									
		60	−1·50											
		80	−0·90	34·39	27·68									
		100	−0·35	34·43	27·68									
		110	0·25	34·58	27·77									
		125	0·65	34·57	27·74									
		150	1·05	34·62	27·77									
		300	1·32	34·66	27·77									
		500	1·15	34·71	27·83									
RS 6	28	0	−1·45	34·01	27·38	—	—	—	**N 100 B**	100–0	0953	1015	⅔	
		5	−1·65	34·01	27·39	—	—	—	,,	117–0	1044	1104	⅔	KT
		10	−1·65	34·01	27·39	—	—	—	**N 50 V**	100–0	2010	2011		
		20	−1·65	34·01	27·39									
		30	−1·70	34·04	27·41									
		40	−1·80	34·22	27·55									
		60	−1·80	34·22	27·55									
		80	−1·80	34·23	27·57									
		100	−1·35	34·36	27·66									
		150	0·50	34·50	27·69									
RS 7	1	—	—	—	—	—	—	—	**N 100 B**	146–0	0944	1006	⅔	KT
RS 8	6	—	—	—	—	—	—	—	—	—	—	—	—	collection of diatoms from melted ice

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
RS 9	70° 02′ 00″ S, 180° 10′ 00″ W	1928 18 xii	2115	—	SW	8	—	—	s. q.	993·6	– 3·0	in heavy pack ice
RS 10	70° 26′ 00″ S, 177° 43′ 00″ E	20 xii	1645	—	SW	8–10	—	—	s.	952·3	– 3·0	
RS 11	72° 02′ 00″ S, 177° 50′ 00″ E	23 xii	1100	—	SW	3	—	—	b. c.	988·1	– 1·0	
RS 12	72° 12′ 00″ S, 177° 50′ 00″ E	23 xii	2159	—	SW	3	SW	3	b. c.	952·3	– 1·0	
RS 13	73° 30′ 00″ S, 179° 00′ 00″ E	27 xii	1318	522 gy. M.	SE	4	SE	4	o.	952·3	– 1·0	
RS 14	73° 32′ 00″ S, 177° 45′ 00″ E	31 xii	1332	—	SW	2	SW	2	b.	999·0	2·0	
RS 15	74° 45′ 00″ S, 179° 45′ 00″ E	1929 1 i	2015	324 bl. St.	NW	3	NW	3	b.	997·5	0·0	
RS 16	74° 42′ 00″ S, 177° 48′ 00″ E	2 i	1805	250 Di. Oz.	N	2	—	—	b.	996·3	1·0	
RS 17	74° 06′ 00″ S, 178° 55′ 00″ E	3 i	0958	—	NW	1	NW	1	b.	1000·4	0·0	
RS 18	73° 07′ 00″ S, 176° 15′ 00″ E	4 i	1530	—	NE	2	NE	2	o.	1001·0	0·0	
RS 19	73° 08′ 00″ S, 175° 50′ 00″ E	6 i	0020	400 h.	NNW	4	—	—	b.	1000·4	0·0	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME		Length of tow (miles)	
											From	To		
RS 9	7	0	– 1·60	33·98	27·37	—	—	—	**N 50 V**	100–0	2207	2208		
		50	– 1·80	34·22	27·55	—	—	—	**N 100 H**	3–0	0320	0345	$2\frac{1}{2}$	
		80	– 0·30	34·36	27·62									
		90	0·20	34·48	27·70									
		100	0·70	34·53	27·71									
		300	1·45	34·67	27·77									
		500	1·30	34·70	27·81									
RS 10	9	0	– 1·00	34·14	27·48	—	—	—	**N 50 V**	100–0	1826	1827		
		50	– 1·80	34·24	27·58									
		80	0·00	34·51	27·73									
		90	0·60	34·58	27·75									
		100	0·85	34·59	27·75									
		300	1·48	34·70	27·80									
		400	1·35	34·70	27·81									
		500	1·20	34·75	27·86									
RS 11	12	—	—	—	—	—	—	—	—	—	—	—	—	collection of diatoms from melted ice
RS 12	12	0	– 0·80	34·18	27·50	—	—	—	**N 100 B**	91–0	2159	2224	$\frac{5}{6}$	KT
		5	– 1·00	34·18	27·51	—	—	—	**N 50 V**	100–0	2346	2347		
		10	– 1·15	34·18	27·51									
		20	– 1·15	34·19	27·52									
		30	– 1·20	34·19	27·53									
		40	– 1·50	34·22	27·55									
		60	– 1·40	34·24	27·57									
		80	– 0·95	34·38	27·67									
		100	– 0·45	34·49	27·73									
		150	0·20	34·58	27·78									
		200	0·80	34·64	27·79									
		300	1·00	34·67	27·80									
		400	1·00	34·66	27·79									
		500	1·00	34·67	27·80									
RS 13	15	10	– 0·80	34·14	27·47	—	—	—	**N 50 V**	100–0	1319	1320		
		20	– 1·05	34·14	27·48									
		40	– 1·45	34·17	27·51									
		60	– 1·60	34·26	27·59									
		80	– 1·20	34·35	27·66									
		100	– 0·80	34·46	27·72									
		150	0·40	34·61	27·80									
		200	0·75	34·61	27·77									
		300	0·00	34·66	27·85									
		400	– 0·30	34·67	27·88									
		515	– 1·97											
RS 14	19	—	—	—	—	—	—	—	**N 100 B**	55–0	1326	1356	2	KT
RS 15	20	—	—	—	—	—	—	—	**N 100 B**	46–0	2018	2105	4	KT
RS 16	21	—	—	—	—	—	—	—	**N 100 B**	37–0	1808	1850	$2\frac{4}{5}$	KT
									,,	91–0	2012	2105	$2\frac{3}{5}$	KT
RS 17	22	—	—	—	—	—	—	—	**N 100 B**	137–0	1008	1030	$\frac{2}{3}$	KT
RS 18	23	—	—	—	—	—	—	—	**N 100 H**	1–0	1530	1550	$\frac{4}{3}$	
									N 100 B	95–0	1618	1640	$\frac{2}{3}$	KT
RS 19	25	0	1·50	—	—	—	—	—	**N 50 V**	100–0	0058	0059		
		10	0·75	34·35	27·56									

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
RS 19 *cont.*	73° 08′ 00″ S, 175° 50′ 00″ E	1929 6 i										
RS 20	72° 30′ 00″ S, 176° 18′ 00″ E	8 i	2130	456 Sn. Sh. Co.	SW	1	—	—	b.	1000·7	− 1·0	
RS 21	73° 30′ 00″ S, 178° 00′ 00″ E	10 i	1040	425 R.	NW–SW	6	—	—	o.	985·4	− 1·0	
RS 22	74° 27′ 00″ S, 179° 07′ 00″ W	15 i	1945	340 Co.	SE	0–1	—	—	b.	993·6	2·0	
RS 23	74° 20′ 00″ S, 179° 50′ 00″ E	17 i	2100	220 Di. Oz.	SE	5	SE	5	o.	989·5	− 3·0	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.^{3}	O_2 cc. p.l.	Gear	Depth (metres)	TIME From	TIME To	Length of tow (miles)	
RS 19 *cont.*		20	− 0·45	34·35	27·63									
		30	− 1·00	34·35	27·65									
		40	− 1·15	34·36	27·65									
		60	− 1·30	34·35	27·66									
		80	− 1·35	34·42	27·70									
		100	− 0·78	34·50	27·75									
		150	0·65	34·61	27·78									
		200	0·35	34·65	27·82									
		250	− 1·25	34·61	27·88									
		300	− 1·75	34·67	27·93									
		380	− 1·95	34·81	28·06									
RS 20	27	0	0·00	—	—	—	—	—	**N 50 V**	100–0	2352	2353		
		10	− 0·45	—	—	—	—	—	**N 100 B**	119–0	0535	0600	1¼	KT
		40	− 0·80											
		60	− 0·95	34·30	27·60									
		100	− 0·90	34·39	27·68									
		150	− 0·80											
		200	0·50	34·59	27·77									
RS 21	29	0	0·40	33·83	27·21	—	—	—	**N 100 H**	0–5	1040	1100	¾	
		5	0·52	33·85	27·22	—	—	—	**N 50 V**	100–0	1511	1512		
		10	0·55	33·85	27·22									
		20	0·55	33·85	27·22									
		30	− 1·05	34·04	27·39									
		40	− 1·40	34·16	27·50									
		60	− 1·50	34·31	27·63									
		80	− 1·00	34·41	27·69									
		100	− 0·35	34·42	27·66									
		150	0·25	34·62	27·81									
		200	0·70	34·62	27·79									
		300	0·20	34·65	27·83									
		400	− 0·30	34·68	27·89									
		420	− 0·30	34·80	27·99	—	—	—	—	—	—	—	—	bottle touched bottom
RS 22	5	0	0·50											
		5	0·50											
		10	0·45	33·93	27·23									
		20	0·20	33·94	27·26									
		30	− 0·30	34·13	27·43									
		40	− 0·60	34·27	27·56									
		60	− 0·98	34·37	27·66									
		80	− 1·10	34·40	27·68									
		100	− 1·20	34·44	27·73									
		150	− 0·65	34·52	27·77									
		200	− 0·45	34·57	27·80									
		250	− 0·70											
		320	− 0·50	34·61	27·85									
RS 23	7	0	0·85	34·17	27·41	—	—	—	**N 50 V**	100–0	2145	2146		
		5	0·70	34·17	27·42									
		10	0·70	34·17	27·42									
		20	0·70	34·17	27·42									
		30	0·70	34·22	27·45									
		35	0·65	34·17	27·42									
		37	− 0·25	34·27	27·55									
		40	− 0·80	34·33	27·61									
		60	− 1·00	34·42	27·69									
		80	− 0·95	34·48	27·75									
		100	− 0·90	34·57	27·83									
		150	− 1·05	34·57	27·83									
		210	− 0·90	34·57	27·83									

Station	Position	Date	Hour	Sounding (metres)	WIND		SEA		Weather	Barometer (millibars)	Air Temp. ° Cent.	Remarks
					Direction	Force	Direction	Force				
RS 24	75° 09′ 00″ S, 179° 32′ 00″ W	1929 22 i	0930	465 Di. Oz.	SE	4	SE	4	b. c.	997·0	− 3·0	
RS 25	74° 46′ 00″ S, 179° 12′ 00″ W	24 i	0930	390 Di. Oz.	SSW	3	SSW	3	b.	994·9	0·0	
RS 26	72° 55′ 00″ S, 179° 53′ 00″ W	30 i	2100	700–900 S. St.	W	2	—	—	b.	992·2	− 1·0	
RS 27	73° 10′ 00″ S, 179° 00′ 00″ E	31 i	1330	800	NE	7	NE	7	o.	978·6	− 3·0	
RS 28	73° 07′ 00″ S, 178° 30′ 00″ E	2 ii	0110	—	NW	3	NW	3	o.	968·5	− 3·0	
RS 29	72° 44′ 00″ S, 179° 55′ 00″ W	14 ii	2100	1000	W	3	W	3	o.	966·8	− 1·0	

Station	Age of moon (days)	HYDROLOGICAL OBSERVATIONS							BIOLOGICAL OBSERVATIONS					Remarks
		Depth (metres)	Temp. ° Cent.	S ‰	σt	pH	P_2O_5 mgm. p.m.³	O_2 cc. p.l.	Gear	Depth (metres)	TIME From	TIME To	Length of tow (miles)	
RS 24	12	0	0·70	34·25	27·48	—	—	—	**N 50 V**	100–0	1053	1054		
		30	0·50	34·32	27·55									
		60	0·05	34·40	27·64									
		80	− 0·80	34·47	27·73									
		100	− 0·40	34·53	27·77									
RS 25	14	0	− 0·85	33·67	27·08									
		5	− 0·85	33·69	27·10									
		10	− 0·85	34·29	27·58									
		20	− 0·90											
		30	− 0·80											
		40	− 0·80											
		60	− 0·75											
		100	− 0·20											
		200	− 0·30											
		340	− 1·10											
RS 26	19	—	—	—	—	—	—	—	**N 50 V**	100–0	2105	2106		
RS 27	20	0	− 0·60	—	—	—	—	—	**N 50 V**	100–0	1430	1431		
		5	− 0·60											
		10	− 0·60											
		20	− 0·60											
		60	− 0·80											
		80	− 0·90											
		100	− 0·90											
RS 28	22	—	—	—	—	—	—	—	**N 100 B**	81–0	0120	0138	$\frac{3}{5}$	KT
RS 29	5	5	− 0·30											
		10	− 0·80											
		20	− 0·85											
		30	− 0·85											
		40	− 0·90											
		60	− 0·90											
		80	− 0·90											
		100	− 0·40											
		150	0·20											
		200	0·60											
		250	0·80											
		300	0·00											
		400	− 1·35											
		500	− 1·35											

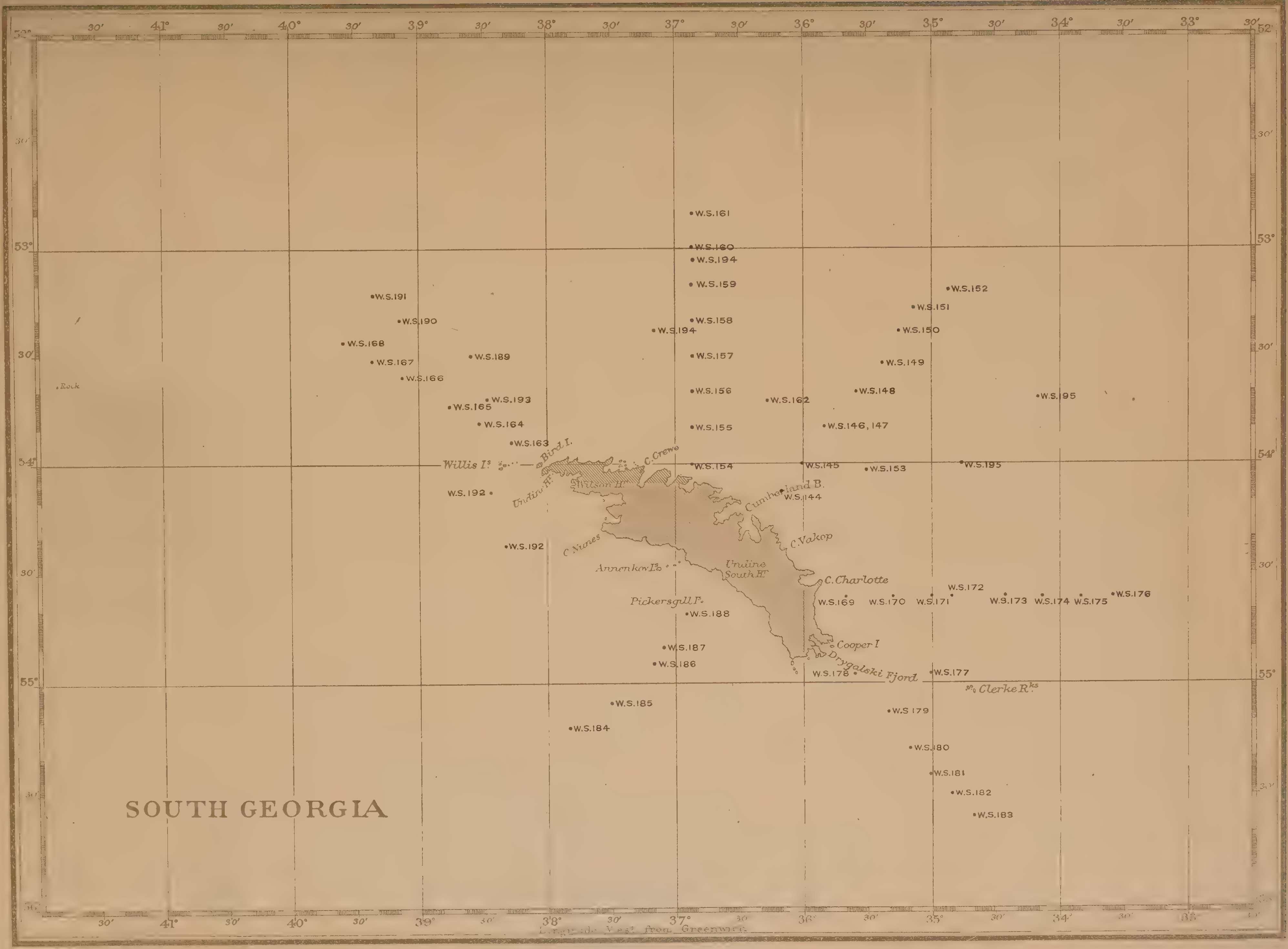
SUMMARISED LIST OF STATIONS

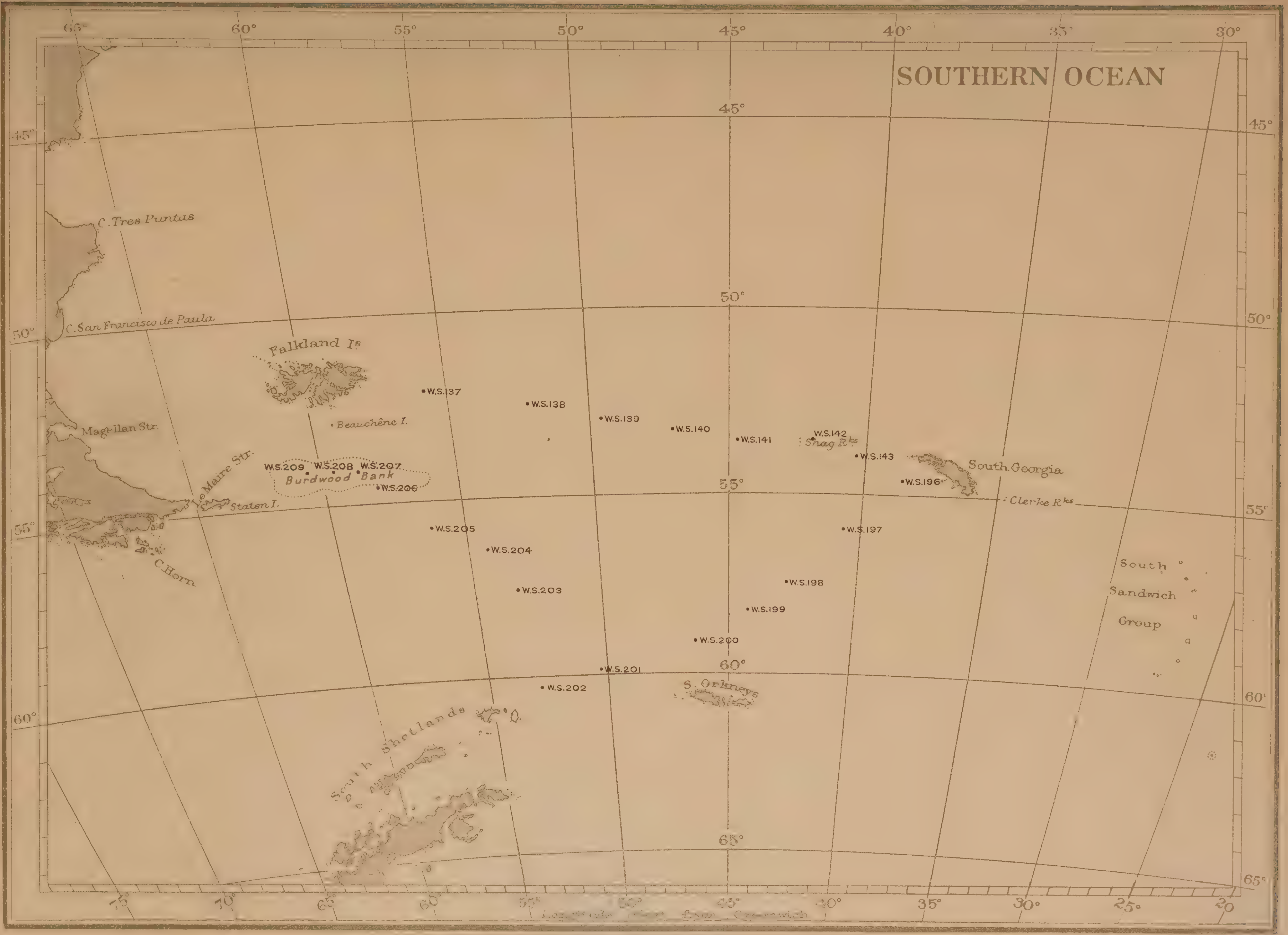
The positions of all stations made by the R.R.S. 'William Scoresby' between January 1928 and the 6th of May 1929 are shown on the charts reproduced in Plates I–VIII. The following list indicates on which chart each of the stations is to be found. The stations made near the South Sandwich Islands are to be found on Plate IX, those made in the Ross Sea on Plate X.

R.R.S. 'WILLIAM SCORESBY'

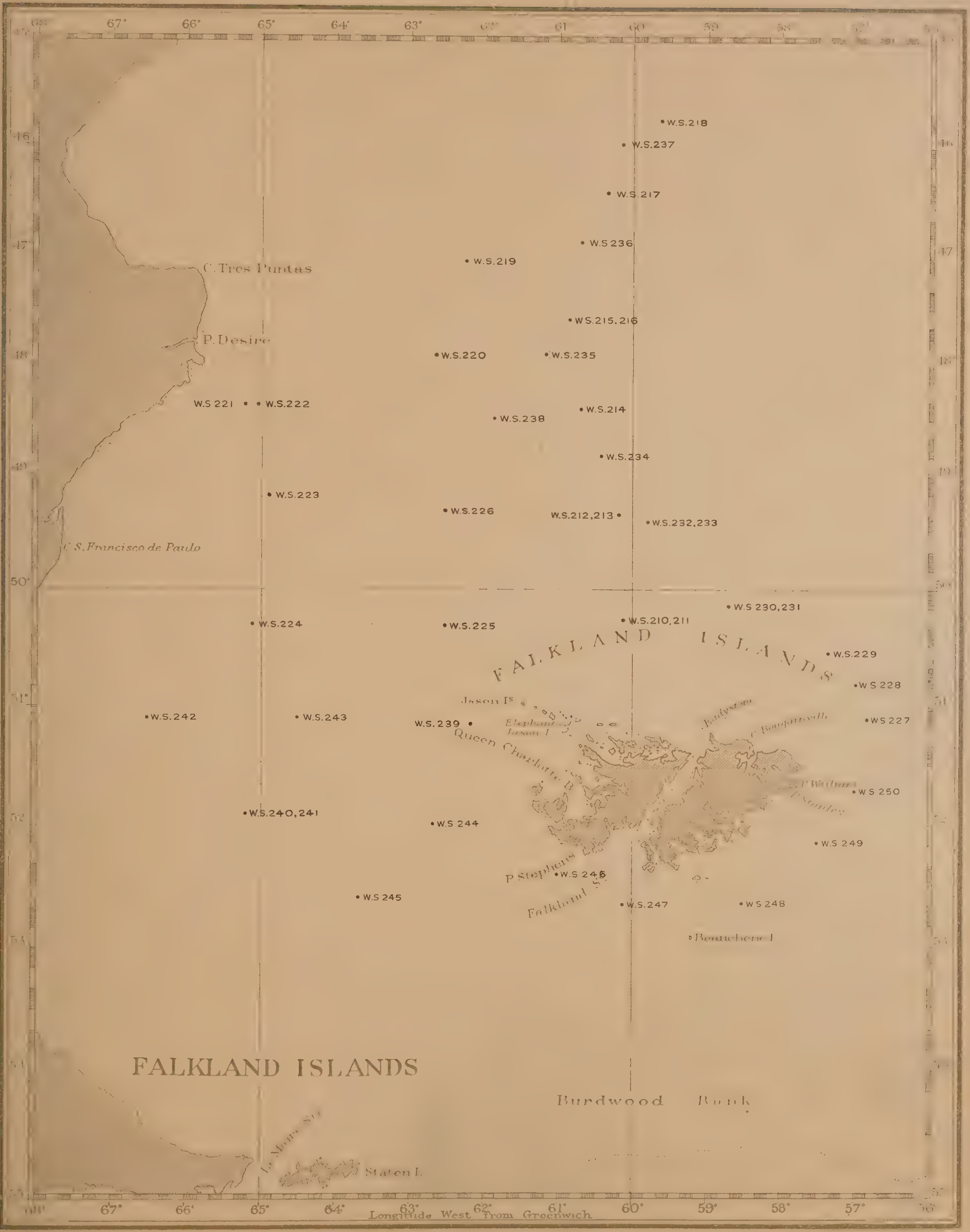
Station	Date	Place	Plate
WS 137–143	8–14. ii. 28	Falkland Islands to South Georgia	II
WS 144–195	19. ii.–13. iii. 28	Off South Georgia	I
WS 196–202	14–23. iv. 28	South Georgia to Clarence Island	II
WS 203–209	25–29. iv. 28	Clarence Island to Falkland Islands	II
WS 210–250	29. v.–20. vii. 28	Off Falkland Islands and between Falkland Islands and South America	III
WS 251–256	19–24. viii. 28	Falkland Islands to South Georgia	V
WS 257–285	27. viii.–18. ix. 28	Off South Georgia	IV
WS 286–288	18–19. ix. 28	Edge of pack-ice to east of South Georgia	V
WS 289–296	1–4. x. 28	Off South Georgia	IV
WS 297–310	4–8. x. 28	Edge of pack-ice to east of South Georgia	V
WS 311–313	10. x.–5. xi. 28	Off South Georgia	IV
WS 314–320	1–16. xii. 28	South Georgia to Falkland Islands	VII
WS 321–373	16. xii. 28–21. i. 29	Off South Georgia	VI
WS 374–381	6–14. ii. 29	South Georgia to South Orkneys and South Shetlands	VII
WS 382–399	15–20. ii. 29	Bransfield Strait, South Shetlands	VIII
WS 400–406	21–24. ii. 29	Drake Strait	VII
WS 407–409	25–26. ii. 29	Staten Island to Falkland Islands	VII
WS 410–416	13–17. iii. 29	Falkland Islands to South Georgia	VII
WS 417–426	10–15. iv. 29	Off South Georgia	VI
WS 427–433	28. iv.–6. v. 29	South Georgia to Port Stanley	VII

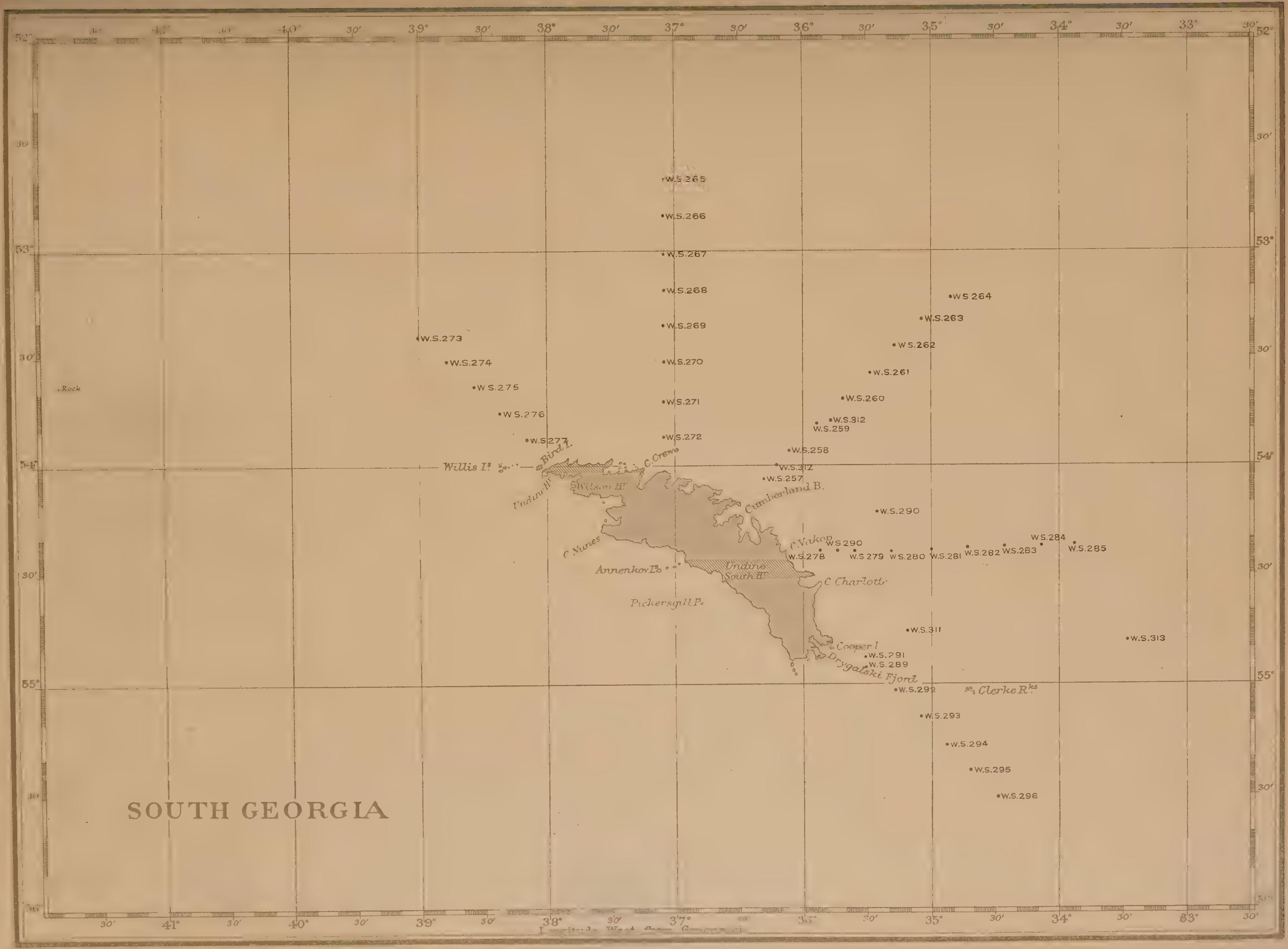
PLATES I—X

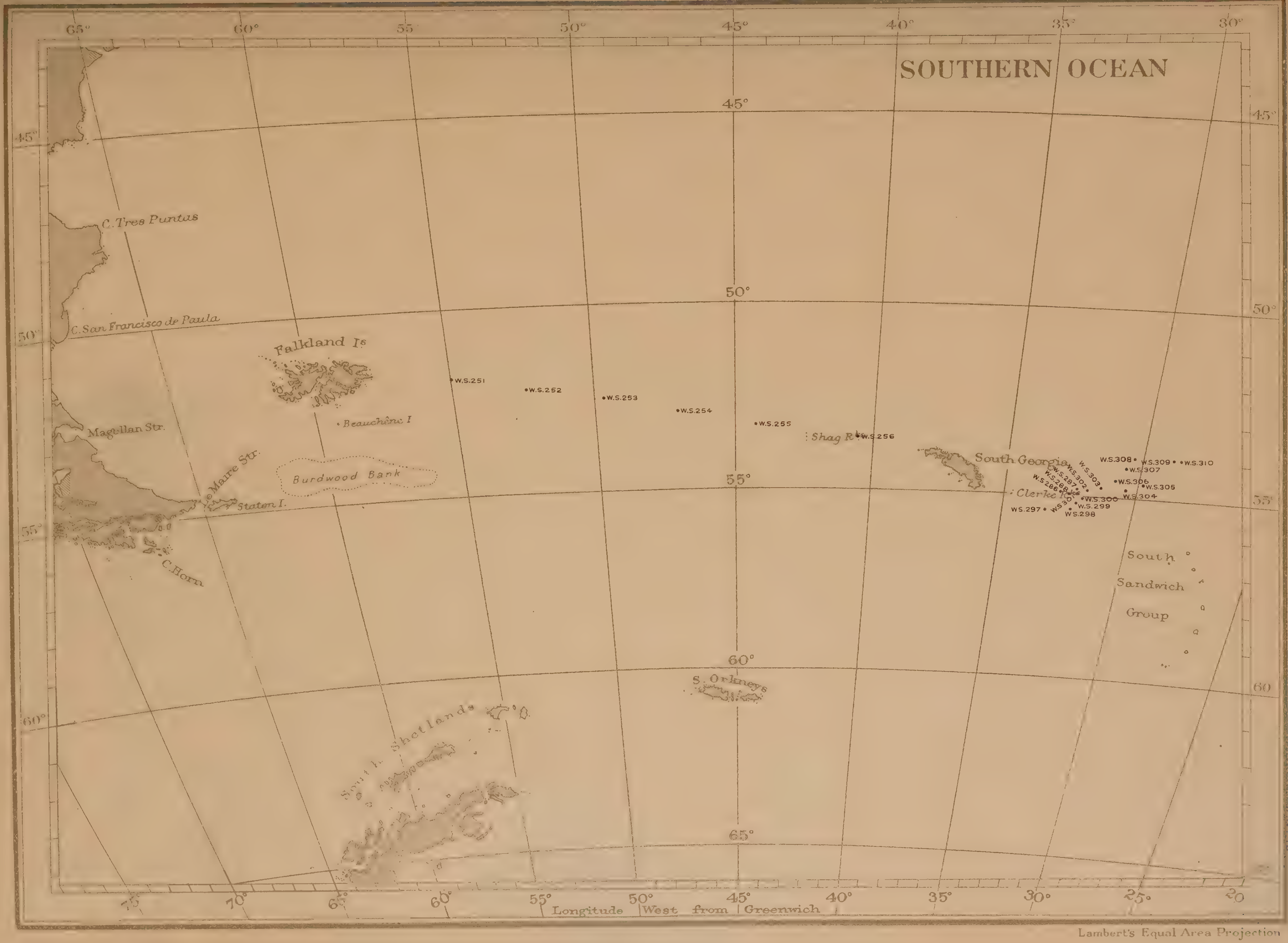

SOUTH GEORGIA
Willis Is
Bird I.
C. Crewe
Undine H.
Wilson H.
Cumberland B.
C. Vakop
C. Nunes
Annenkov Is
Undine South H.
C. Charlotte
Pickersgill F.
Cooper I
Drygalski Fjord
Clerke Rks
Rock
W.S.161
W.S.160
W.S.194
W.S.159
W.S.158
W.S.194
W.S.157
W.S.156
W.S.155
W.S.154
W.S.191
W.S.190
W.S.168
W.S.167
W.S.166
W.S.189
W.S.193
W.S.165
W.S.164
W.S.163
W.S.192
W.S.192
W.S.152
W.S.151
W.S.150
W.S.149
W.S.148
W.S.162
W.S.146, 147
W.S.145
W.S.153
W.S.195
W.S.195
W.S.144
W.S.172
W.S.169
W.S.170
W.S.171
W.S.173
W.S.174
W.S.175
W.S.176
W.S.188
W.S.187
W.S.186
W.S.185
W.S.184
W.S.178
W.S.177
W.S 179
W.S.180
W.S.181
W.S.182
W.S.183
52°
53°
30′
54°
30′
55°
41°
40°
39°
38°
37°
36°
35°
34°
33°
30′
Longitude West from Greenwich

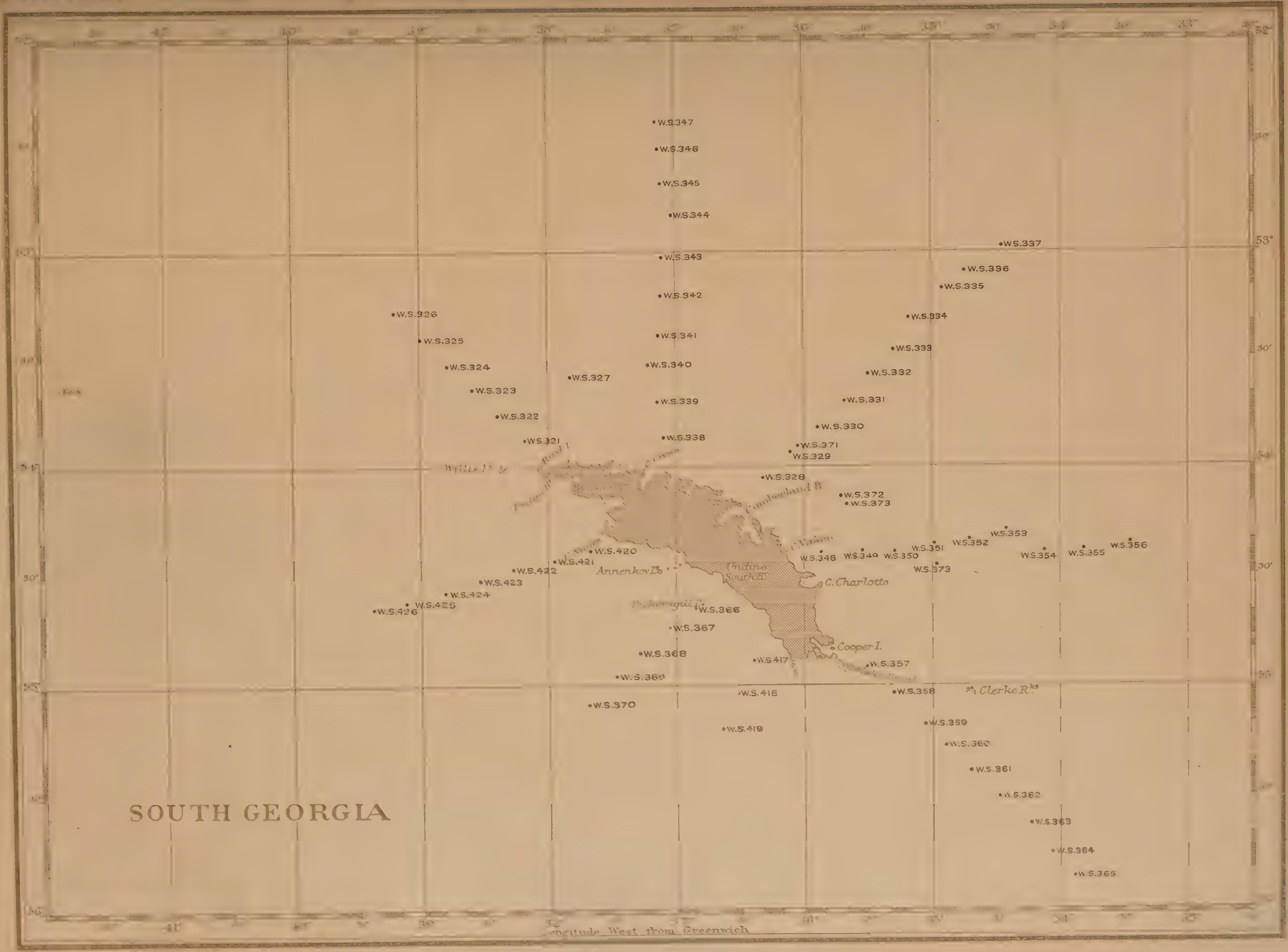

SOUTHERN OCEAN
C. Tres Puntas
C. San Francisco de Paula
Falkland Is.
Beauchêne I.
Magellan Str.
Le Maire Str.
Staten I.
C. Horn
Burdwood Bank
W.S. 137
W.S. 138
W.S. 139
W.S. 140
W.S. 141
W.S. 142
Shag Rks.
W.S. 143
South Georgia
W.S. 196
Clerke Rks.
W.S. 197
W.S. 198
W.S. 199
W.S. 200
W.S. 201
W.S. 202
W.S. 203
W.S. 204
W.S. 205
W.S. 206
W.S. 207
W.S. 208
W.S. 209
S. Orkneys
South Shetlands
South Sandwich Group
45°
50°
55°
60°
65°
75°
70°
40°
35°
30°
25°
20
Longitude West from Greenwich

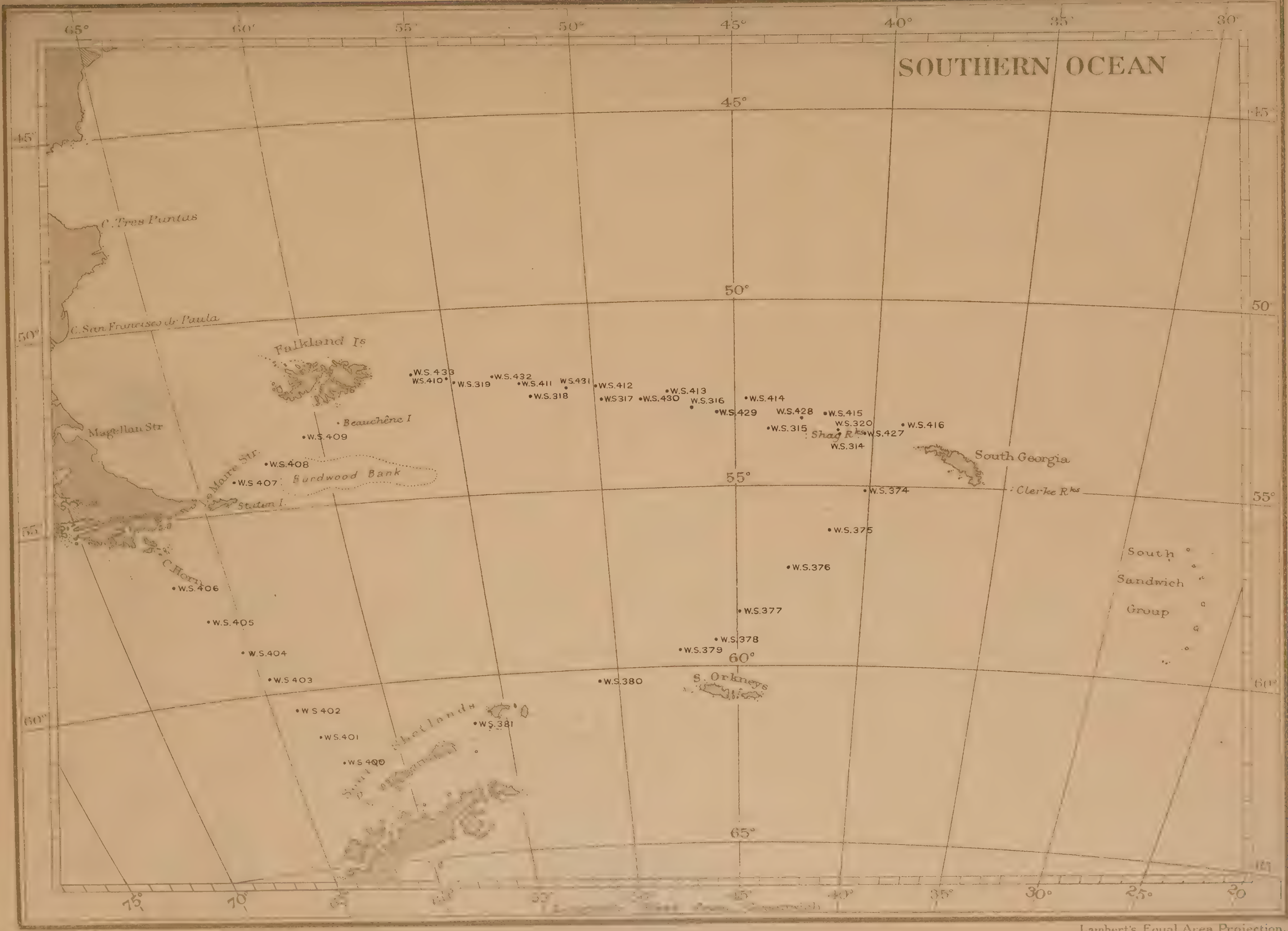
Lambert's Equal Area Projection


FALKLAND ISLANDS
W.S.218
W.S.237
W.S.217
W.S 236
W.S.219
C. Tres Puntas
W.S.215,216
P. Desire
W.S.220
W.S.235
W.S 221
W.S.222
W.S.214
W.S.238
W.S.234
W.S.223
W.S.226
W.S.212,213
W.S.232,233
C.S. Francisco de Paulo
W.S 230,231
W.S.224
W.S.225
W.S.210,211
FALKLAND ISLANDS
W.S.229
W S 228
Jason Is
W.S.242
W.S.243
W.S.239
Elephant Jason I
Queen Charlotte B.
C. Bougainville
W S 227
P. William
Stanley
W S 250
W.S.240,241
W.S 244
W.S 249
P. Stephens
W.S 246
W.S 245
Falkland S.
W.S.247
W S 248
Beauchene I
Burdwood Bank
Le Maire St.
Staten I.
67°
66°
65°
64°
63°
62°
61°
60°
59°
58°
57°
47°
50°
51°
52°
Longitude West from Greenwich


SOUTH GEORGIA
W.S. 265
W.S. 266
W.S. 267
W.S. 268
W.S. 269
W.S. 270
W.S. 271
W.S. 272
W.S. 264
W.S. 263
W.S. 262
W.S. 261
W.S. 260
W.S. 312
W.S. 259
W.S. 258
W.S. 312
W.S. 257
W.S. 273
W.S. 274
W.S. 275
W.S. 276
W.S. 277
W.S. 290
W.S. 290
W.S. 278
W.S. 279
W.S. 280
W.S. 281
W.S. 282
W.S. 283
W.S. 284
W.S. 285
W.S. 311
W.S. 313
W.S. 291
W.S. 289
W.S. 292
W.S. 293
W.S. 294
W.S. 295
W.S. 296
Rock
Willis Is.
Bird I.
Undine H.
Wilson H.
C. Crewe
Cumberland B.
C. Nunes
C. Vakop
Annenkov Is.
Undine South H.
C. Charlotte
Pickersgill Is.
Cooper I.
Drygalski Fjord
Clerke Rks.
52°
53°
54°
55°
56°
30′
33°
34°
35°
36°
37°
38°
39°
40°
41°
Longitude West from Greenwich

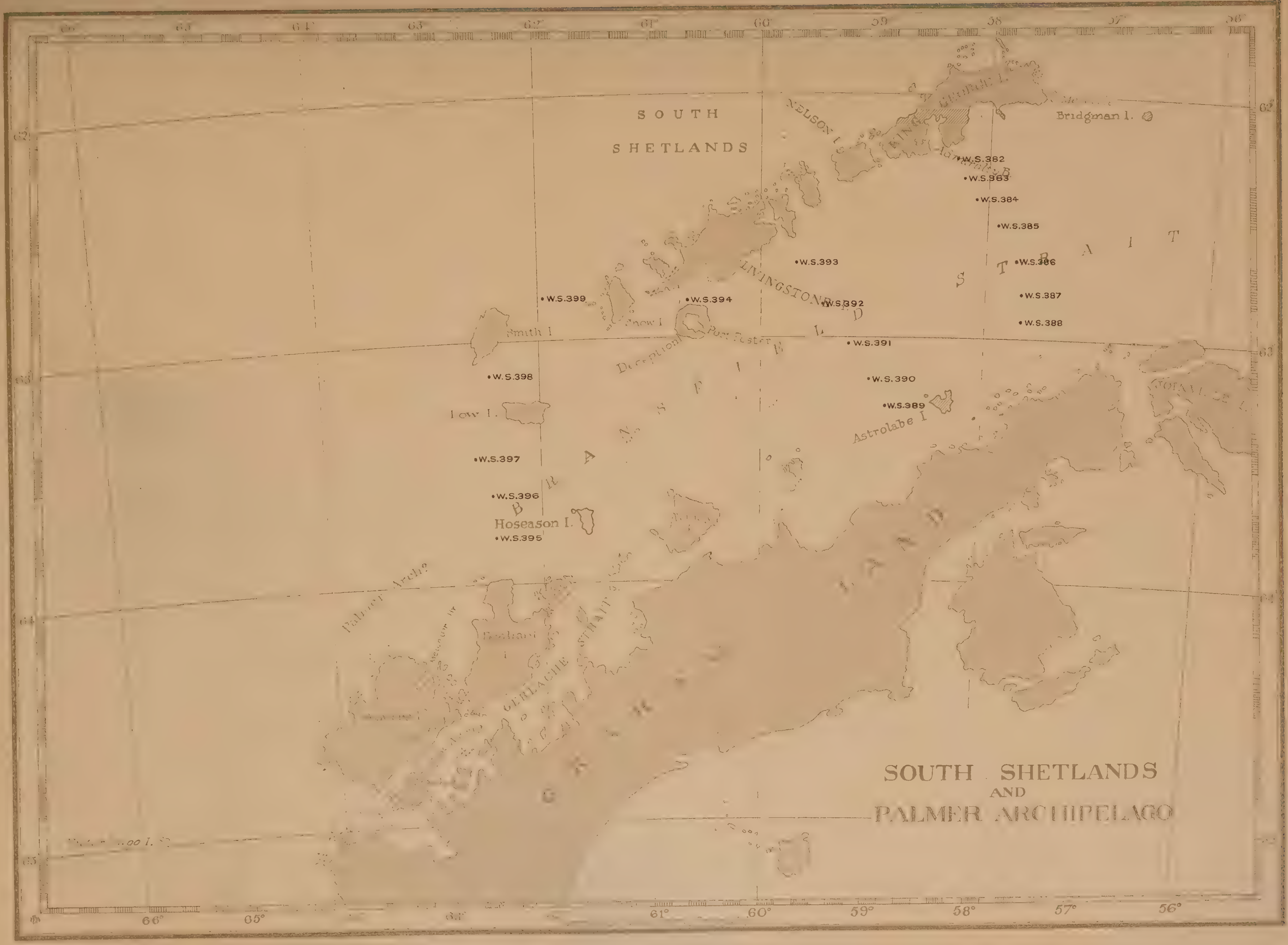

SOUTHERN OCEAN
C. Tres Puntas
C. San Francisco de Paula
Falkland Is
Beauchêne I
Magellan Str.
Maire Str.
Staten I.
Burdwood Bank
C. Horn
W.S. 251
W.S. 252
W.S. 253
W.S. 254
W.S. 255
Shag R.
W.S. 256
South Georgia
Clerke R.
W.S. 286
W.S. 287
W.S. 288
W.S. 297
W.S. 298
W.S. 299
W.S. 300
W.S. 301
W.S. 302
W.S. 303
W.S. 304
W.S. 305
W.S. 306
W.S. 307
W.S. 308
W.S. 309
W.S. 310
South Sandwich Group
S. Orkneys
South Shetlands
45°
50°
55°
60°
65°
75°
70°
65°
60°
55°
50°
45°
40°
35°
30°
25°
20
Longitude West from Greenwich
Lambert's Equal Area Projection

SOUTH GEORGIA
W.S.347
W.S.346
W.S.345
W.S.344
W.S.337
W.S.343
W.S.336
W.S.335
W.S.342
W.S.326
W.S.334
W.S.325
W.S.341
W.S.333
W.S.324
W.S.340
W.S.327
W.S.332
W.S.323
W.S.339
W.S.331
W.S.322
W.S.330
W.S.321
W.S.338
W.S.371
W.S.329
Willis Is
Bird I
W.S.328
Cumberland B
W.S.372
W.S.373
W.S.353
W.S.352
W.S.351
W.S.356
W.S.355
W.S.354
W.S.350
W.S.349
W.S.348
C. Nattov
W.S.420
W.S.421
W.S.373
W.S.422
Annenkov I.
Undine South H.
C. Charlotte
W.S.423
W.S.424
W.S.425
W.S.426
Pickersgill I.
W.S.366
W.S.367
W.S.368
Cooper I.
W.S.417
W.S.357
W.S.369
W.S.418
W.S.358
Clerke Rks
W.S.370
W.S.419
W.S.359
W.S.360
W.S.361
W.S.362
W.S.363
W.S.364
W.S.365
52°
53°
54°
55°
56°
30'
33°
34°
35°
36°
37°
38°
39°
40°
41°
Longitude West from Greenwich


SOUTHERN OCEAN
C. Tres Puntas
C. San Francisco de Paula
Magellan Str
Falkland Is
Beauchêne I
Le Maire Str
Staten I.
Burdwood Bank
C. Horn
South Georgia
Shag Rks
Clerke Rks
South Sandwich Group
S. Orkneys
South Shetlands
W.S. 433
W.S. 410
W.S. 319
W.S. 432
W.S. 411
W.S. 431
W.S. 318
W.S. 412
W.S. 317
W.S. 430
W.S. 413
W.S. 316
W.S. 414
W.S. 429
W.S. 428
W.S. 315
W.S. 415
W.S. 320
W.S. 427
W.S. 314
W.S. 416
W.S. 374
W.S. 375
W.S. 376
W.S. 377
W.S. 378
W.S. 379
W.S. 380
W.S. 381
W.S. 409
W.S. 408
W.S. 407
W.S. 406
W.S. 405
W.S. 404
W.S. 403
W.S. 402
W.S. 401
W.S. 400
45°
50°
55°
60°
65°
30°
35°
40°
70°
75°
20°
25°
Longitude West from Greenwich

Lambert's Equal Area Projection.

PLATE VIII


SOUTH SHETLANDS
AND
PALMER ARCHIPELAGO
SOUTH
SHETLANDS
KING GEORGE I.
NELSON I.
Bridgman I.
LIVINGSTON I.
Snow I.
Smith I.
Deception I.
Port Foster
Low I.
Hoseason I.
Astrolabe I.
JOINVILLE I.
BRANSFIELD STRAIT
GRAHAM LAND
GERLACHE STRAIT
Palmer Archo.
W.S.382
W.S.383
W.S.384
W.S.385
W.S.386
W.S.387
W.S.388
W.S.389
W.S.390
W.S.391
W.S.392
W.S.393
W.S.394
W.S.395
W.S.396
W.S.397
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63°
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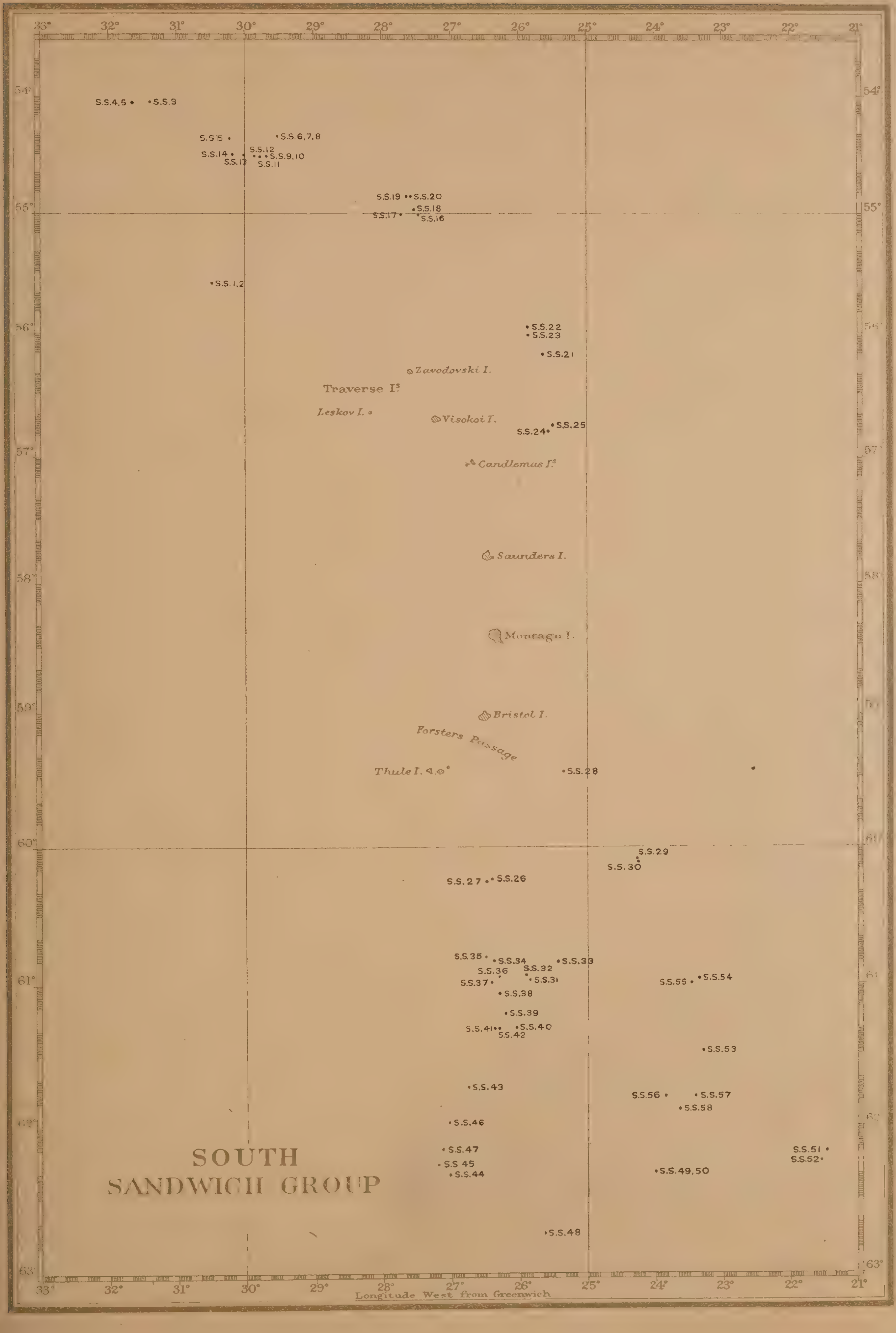
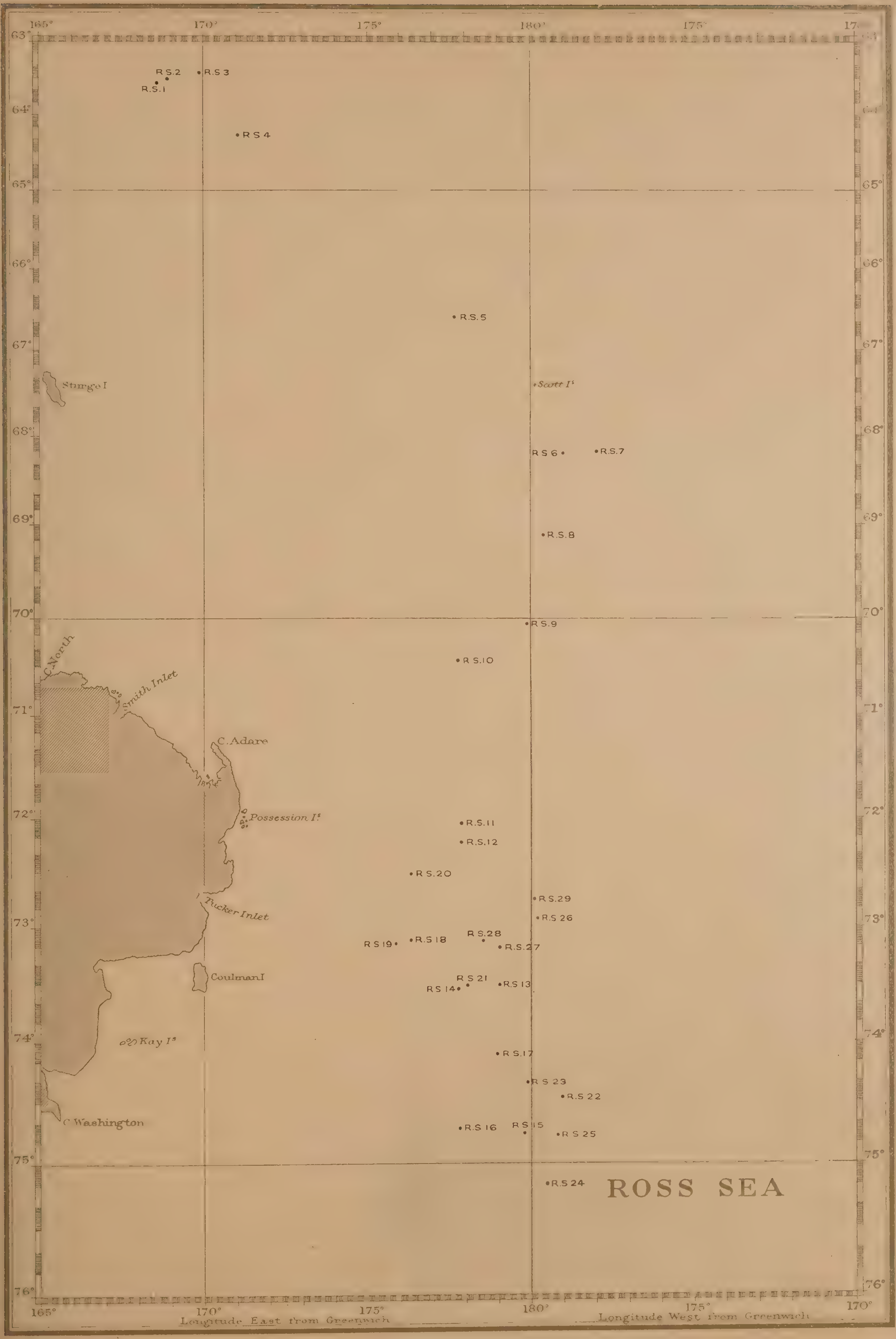
61°
60°
59°
58°
57°
56°


SOUTH SANDWICH GROUP
S.S.4,5
S.S.3
S.S15
S.S.6,7,8
S.S.14
S.S.12
S.S.9,10
S.S.13
S.S.11
S.S.19
S.S.20
S.S.18
S.S.17
S.S.16
S.S.1,2
S.S.22
S.S.23
S.S.21
Zavodovski I.
Traverse I^s
Leskov I.
Visokoi I.
S.S.24
S.S.25
Candlemas I^s
Saunders I.
Montagu I.
Bristol I.
Forsters Passage
Thule I.
S.S.28
S.S.29
S.S.30
S.S.27
S.S.26
S.S.35
S.S.34
S.S.33
S.S.36
S.S.32
S.S.37
S.S.31
S.S.55
S.S.54
S.S.38
S.S.39
S.S.41
S.S.40
S.S.42
S.S.53
S.S.43
S.S.56
S.S.57
S.S.58
S.S.46
S.S.47
S.S 45
S.S.44
S.S.49,50
S.S.51
S.S.52
S.S.48
33°
32°
31°
30°
29°
28°
27°
26°
25°
24°
23°
22°
21°
54°
55°
56°
57°
58°
59°
60°
61°
62°
63°
Longitude West from Greenwich


165°
170°
175°
180°
175°
63°
64°
65°
66°
67°
68°
69°
70°
71°
72°
73°
74°
75°
76°
R.S.1
R.S.2
R.S 3
R S 4
R.S.5
Sturge I
Scott Iˢ
R S 6
R.S.7
R.S.8
R.S.9
R S.10
C. North
Smith Inlet
C. Adare
Possession Iˢ
R.S.11
R.S.12
R S.20
R.S.29
R.S 26
Tucker Inlet
R S 19
R.S 18
R.S.28
R.S.27
Coulman I
R S 21
R S 14
R.S 13
Kay Iˢ
R S.17
R S 23
R.S 22
C Washington
R.S 16
R S 15
R S 25
R.S 24
ROSS SEA
165°
170°
175°
180°
175°
170°
Longitude East from Greenwich
Longitude West from Greenwich

Discovery Reports. Vol. III, pp. 133–198, *Plates XI–XXXI, text-figs.* 1–21, *November,* 1931.]

THE SOUTH SANDWICH ISLANDS

By

STANLEY KEMP, Sc.D., F.R.S., and A. L. NELSON, R.N.R.

with a Report on Rock Specimens by

G. W. TYRRELL, A.R.C.Sc., D.Sc., F.G.S., F.R.S.E.

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CHART OF SOUTH SANDWICH GROUP . . . . *in pocket at end*

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THE SOUTH SANDWICH ISLANDS

By Stanley Kemp, Sc.D., F.R.S., and A. L. Nelson, R.N.R.

(Plates XI–XXXI, text-figs. 1–21)

INTRODUCTION

At the end of February 1930 the R.R.S. 'Discovery II' had occasion to visit the South Sandwich Islands. We had just completed a survey of the plankton and hydrology of the South Georgia whaling grounds, and, following a prearranged programme, it was our intention to begin a line of deep-water stations extending from the west of the South Sandwich Islands to a point on the Burdwood Bank near Cape Horn. We had already learnt from the vessels of the whaling fleet that the pack-ice, which often surrounds the islands, was far to the south of its normal limits, and on reaching the group we found that except for bergs and growlers the whole sea was open. In view of our very scanty knowledge of this Dependency of the Falkland Islands, we felt with Capt. Carey that the exceptional opportunity which thus presented itself should not be lost, and with the approval of the Discovery Committee twenty days were spent in examining the islands.

Our primary object was to make as good a survey of the group as time permitted. We therefore steamed at slow speed round each island, fixing its position astronomically, and plotting its coast-line and outlying dangers by running survey: possible anchorages were explored, and whenever the mountain tops became free of mist and cloud, their heights were determined.[1] At the same time soundings were continuously taken with the echo-sounding apparatus, giving some idea of the conformation of the sea-bottom in the vicinity of the islands. These soundings were taken by members of the scientific staff, the majority of them by Mr H. F. P. Herdman. Numerous photographs were taken by Dr E. H. Marshall, and sketches from various points of view were made by Lt.-Cmdr. J. Irving: we owe to them a series of illustrations which add largely to the value of this report. Notes were made on the topography of the islands and on the birds and seals, but unfortunately we had no expert geologist with us. The bold cliff faces often showed magnificent exposures of volcanic rock, and we felt that a geologist might have done much, even from the deck of the ship.

At several selected points between the islands observations were made on the hydrology and plankton, and on occasions when it was impossible to continue the survey owing to thick or heavy weather, trawls and dredges were shot, resulting in an interesting collection of the marine fauna. Throughout the group landings are difficult by reason of the steep coast and ceaseless swell. In all, five attempts at landing were made: of these only one, on Thule Island, was successful, and here geological specimens were taken and samples collected of the meagre land fauna and flora.

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[1] The whole of this work was very efficiently carried out by the Navigating Officer, Lieut. A. L. Nelson, and its rapid completion and accuracy of detail are entirely due to his unremitting efforts: observations of heavenly bodies were seldom possible owing to the thick weather, but he never missed an opportunity of obtaining them and showed tireless energy in prosecuting the survey.—*S. Kemp*, *W. M. Carey*.

Among the more interesting results of the work are (i) the confirmation of Cook's statement that there are two islands in the Candlemas Group, a fact which has been denied in recent years, (ii) the observations on the present state of volcanic activity in the islands, and (iii) the discovery of a deep enclosed basin, formerly a crater, between Cook and Thule Islands.

We had hoped that Capt. W. M. Carey, to whom we are indebted in many ways, would have shared with us the responsibility of authorship, for the paper, far from representing merely our own individual work, is the result of the united efforts of the entire ship's company. Since he has declined we must acknowledge the help which he has given us in the preparation of this report and express our gratitude to him for his able conduct of the survey. We have received so much help from all the ship's officers and scientific staff that it is perhaps invidious to discriminate, but we feel that we should thank Mr F. C. Fraser for assistance on geological points, Dr E. H. Marshall for compiling lists of birds seen at the various islands, and Dr N. A. Mackintosh and Mr H. F. P. Herdman for drawing certain figures for us. Our notes on the hydrology of the submarine crater in Douglas Strait owe much to discussion with Mr H. F. P. Herdman and Mr A. J. Clowes.

Mr J. M. Wordie has kindly read through the manuscript of this report, and we are indebted to him for a number of suggestions.

We have derived much assistance from a folio of typewritten "Notes on the S. Sandwich Islands", dated September 1927, and compiled in the Hydrographic Department of the Admiralty. These notes provided us with a summary of previous exploration of the islands; they included extracts from all the more important sources, and—most valuable of all—supplied us with a translation of the relevant parts of Bellingshausen's narrative of his Antarctic voyage, a scarce work published in Russian. With the folio were numerous illustrations, reproductions of views given in Bellingshausen's atlas and of sketch-plans by C. A. Larsen. These notes enabled us to make better use of our opportunities than we could otherwise have done, and we are indebted to them for part of the information contained in our history of the islands.

HISTORY OF THE ISLANDS

The islands composing the South Sandwich Group are eleven in number; as will be seen from Fig. 1 they are the most easterly of the Dependencies of the Falkland Islands. The positions and names of the islands are shown in Fig. 2.

The group was discovered by Captain James Cook,[1] R.N., in H.M.S. 'Resolution' on January 31 1775, during his second circumnavigation of the world.

---

[1] Cook, *A voyage to the South Pole and round the World*..., II, pp. 224–30 (London, 1777).

It was Cook's main objective on this voyage to prove or disprove the existence of an Antarctic continent, and on leaving South Georgia—one of his more notable discoveries in the South Atlantic—he sailed south to about lat. 60° S and then turned eastward. On the morning of January 31 land was sighted, and the fog clearing a little, he was able to perceive three rocky islets of considerable height, with, to the east of them, "an elevated coast whose lofty snow-clad summits were seen above the clouds".[1] The

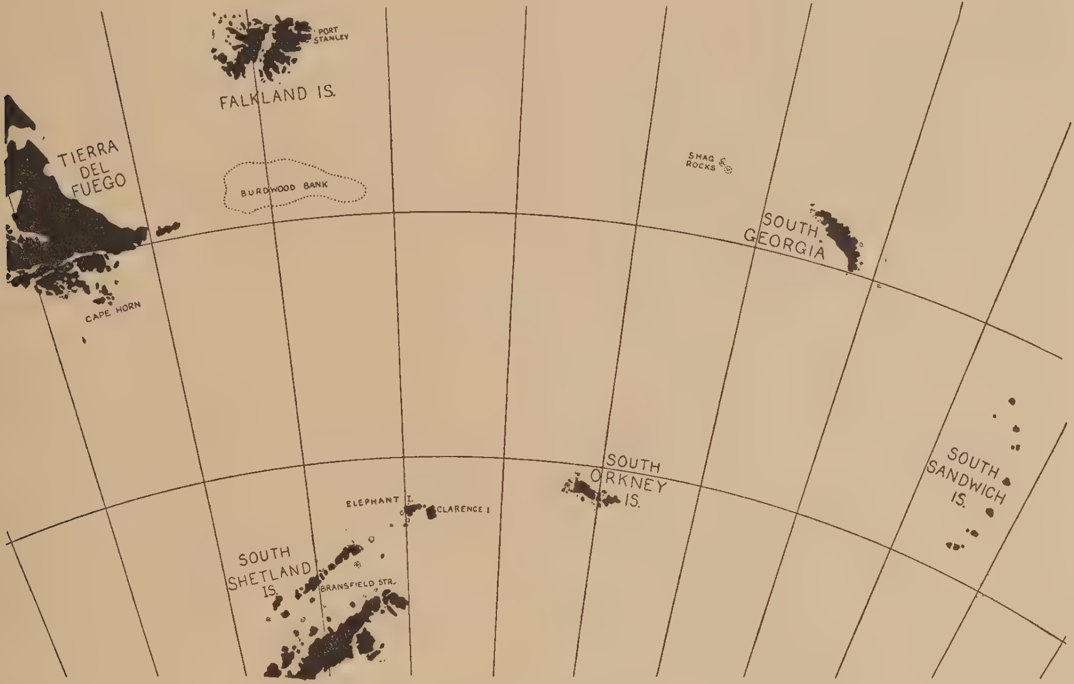

Fig. 1. The Falkland Islands and their Dependencies.

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[1] Forster, in his *Voyage round the World*, II, p. 536 (1777), says: "Thick clouds veiled the upper parts of the mountains, but one immense peak appeared towering beyond them, covered by snow. It was agreed by all present that the perpendicular height of this mountain could not be far short of two miles".

We are indebted to Dr H. R. Mill for an extract from an unofficial and anonymous account of Cook's voyage, entitled "Journal of the Resolution's voyage in 1772–75 on Discovery to the Southern Hemisphere...". It is dated 1775 and was written by James Marra, gunner's mate. The author appears to have been under the impression that both South Georgia and Southern Thule were outlying parts of an Antarctic continent, though Cook was of course well aware that the former was an island. Marra remarks on "the horrid appearance the different views of the land exhibited" and, referring apparently to Cape Bristol, says "in some places the mountains rose higher than even Mr Foster, who had traversed the most mountainous parts of Europe, had ever beheld before. Our journalist has given a drawing of one, among many others, which he says, rose seventeen miles above the horizon, and whose top reached higher than the clouds. It was situated about the 59th degree of southern latitude and in east longitude 330 deg. nearly". In the illustration a praiseworthy attempt is made to show a small island 17 miles in height.

Dr Mill thinks that this grotesque error is to be explained in the following way. Distances may have been entered in the log of the 'Resolution' as minutes of latitude—meaning miles—and the author, finding a statement that the mountain was 17′ above the horizon, concluded that these also were miles, without realizing that minutes of arc were intended.

westernmost and highest of the rocky islets received the name of Freezeland Peak, after the man who first sighted it, and the land beyond, now known as Bristol Island, was called Cape Bristol. At the same time other land was seen to the south, and this Cook approached, naming it Southern Thule, “because it is the most southern land that has ever yet been discovered”. He thought it probable that the two lands were connected and that the space between them was a bay—which he called Forsters’ Bay.

Finding that he could not weather Southern Thule Cook stood to the north and again passed Freezeland Peak. To the north of Cape Bristol no land could be seen to the east, a discovery which “relieved us from the fear of being carried by the swell on the most horrible coast in the world”.

Next morning more land was sighted. It proved to be a high promontory, which was named Cape Montagu, and since he thought he saw land between it and Cape Bristol, Cook concluded that the two were connected. He adds: “I was sorry I could not determine this with greater certainty; but prudence would not permit me to venture near a coast, subject to thick fogs, on which there was no anchorage; where every port was blocked or filled up with ice; and the whole country, from the summits of the mountains, down to the very brink of the cliffs which terminate the coast covered many fathoms thick with everlasting snow. The cliffs alone was all which was to be seen like land”.

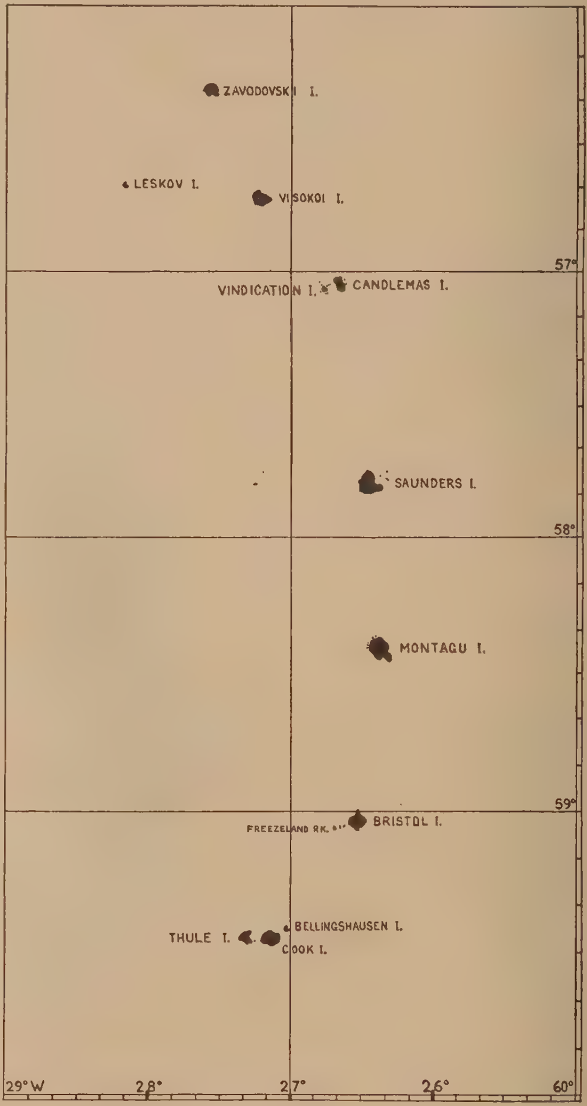

Fig. 2. The South Sandwich Islands.

Later in the day more land was seen to the north and next morning (February 2) yet more, appearing as “two hummocks just peeping over the horizon”. Cook approached the land seen the previous evening, finding it to be of considerable height, with its summit lost in the clouds, and covered with ice and snow “except on a projecting point on the north side and two hills seen over this point which probably might be two islands. These only were clear of snow and seemed to be covered with green turf". The weather becoming hazy Cook continued to the north, leaving the land "under the supposition of its being an island" with the name Saunders Isle. On the morning of the 3rd he came up with the two hummocks seen the previous day; he found them to be two islands with a rock between, and he called them the Candlemas Islands, after the day on which they were discovered.

Cook then continued his voyage to the east and thus missed sighting the three northern islands of the group. In his journal on February 6 he writes: "I concluded that what we had seen, which I named Sandwich Land, was either a group of islands, or else a point of a continent. For I firmly believe that there is a track of land near the pole which is the source of most of the ice that is spread over this vast Southern Ocean".

Forty-five years later Cook's discoveries were completed and extended by the remarkable work of Capt. Fabian Gottlieb von Bellingshausen[1] of the Imperial Russian Navy in the corvettes 'Vostok' and 'Mirnii'.

On December 22 1819, steering east-north-east, an island was sighted to the north of any of the land discovered by Cook. It proved to be small, high and snow-covered, and Bellingshausen named it Leskov, after the first lieutenant of the 'Vostok'. On the next day another island, which he called Visokoi, was seen to the east. It had a high mountain in the middle and was almost completely covered with ice and snow. "The island is round with a circumference of about 12 miles, but it is impossible to land on the steep rocky shore." Thinking that certain thick black clouds to the north betokened more land Bellingshausen sailed in that direction, discovering a third island with a crater "from which a thick vapour of a most unpleasant odour continually rose. As we sailed with the wind along the island we noted that this vapour made a permanent dense cloud and gave the impression from afar of the thick smoke which rises from the funnel of an engine". Bellingshausen sailed round the island and called it Zavodovski, after the second-in-command of the 'Vostok'. He hove to for the night and next day lowered a boat and succeeded in making a landing. The shore party reported that half-way up the mountain they found the ground warm, and that there were many penguins sitting on their eggs. "A particularly bad odour came from the great quantity of bird dung, and forced them to return quickly to the vessel."

Bellingshausen called these three new islands the Marquis de Traverse Islands, and then turned south to examine the lands discovered by Cook. With three chronometers in place of the one which Cook carried he was able to determine their positions with greater accuracy, and by sailing to the eastward of them he proved conclusively that all were islands and that Cape Montagu, Cape Bristol and Southern Thule were not parts of an Antarctic continent. He pushed far to the south of Southern Thule, meeting much pack-ice, and on January 4 1820, reached lat. 65° 25′ S, when, "with a range of 40 miles from the look-out, no continuation of the Sandwich Islands could be seen towards the South". Returning north he passed to the west of Southern Thule and Bristol and then steered east "to make a new attempt to get to the southward at another more favourable point".

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[1] Bellingshausen's narrative of his Antarctic voyage is extant only in Russian. The extracts here given are from a translation made for the Hydrographic Department of the Admiralty. An account of the voyage will be found in Mill, *The Siege of the South Pole*, p. 114 (London, 1905).

Bellingshausen reported that there were three Candlemas Islands instead of two—one of his very few errors; but he stated correctly that there were three islands in Southern Thule. For one of the latter he retained the name Thule, while another he called Cook Island. Cook had named the group Sandwich Land, and Bellingshausen says: "Captain Cook saw these islands first and, as he had thus named them they must stand, as a memory of the daring explorer to be handed on to posterity. Consequently I call them, also, Sandwich Islands".

Since the time of Bellingshausen little survey work has been attempted at the islands, and though they must frequently have been sighted by sealers in the last century and in recent years by whalers, very few have recorded their visits.

Morrell,[1] whose account of his voyages is generally discredited,[2] says that in 1823 he examined the islands from the Candlemas Group to Southern Thule. He remarks that he saw "nine burning volcanoes" and that "three of the islands had vomited out so much of their entrails that their surfaces were nearly even with the water". In 1830 Capt. James Brown,[3] when engaged on a sealing voyage in the schooner 'Pacific', rediscovered the three northern islands first found by Bellingshausen. Knowing nothing of Bellingshausen's voyage he gave them new names, and with less reason gave a new name also to Saunders Island. His men landed on Zavodovski and noted that steam was issuing from the ground at many points as well as from the main crater. On Visokoi they found "a burning mountain with smoke issuing in different places". In the same year (1830) John Biscoe[4] in the brig 'Tula', with the cutter 'Lively' in company, in the voyage in which he discovered Enderby Land, visited Montagu[5] and sighted Bristol and Saunders Islands.

From 1830 there appear to be no records of any visits to the islands until 1908, when Capt. C. A. Larsen,[6] the pioneer of modern Antarctic whaling, examined the group in the S.S. 'Undine' in the hope of finding a site for a whaling station. Owing to lack of harbours he failed in his main object, but in the course of his expedition he was able to carry out some very useful work. Of the eleven islands he visited seven: he was unable to approach the Thule Group by reason of pack-ice, and he appears to have missed the south-western island of the Candlemas Group in the fog. Larsen was extremely successful in making landings on the islands. Hitherto Zavodovski was the only island on which a landing had been reported. On this island Larsen landed, and he or some of his party also succeeded in getting ashore on Candlemas, Saunders, Montagu and Bristol. At each of these islands geological specimens were obtained, and trawls and dredges for collecting zoological material were used at a number of localities.[1]

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[1] Morrell, *A Narrative of Four Voyages...*, p. 66 (New York, 1832).

[2] See Fricker, *The Antarctic Regions*, pp. 62–4 (London, 1904).

[3] See E. Fanning, *Voyages round the World*, pp. 440–3 (London, 1834).

[4] The journal of John Biscoe's voyage, in the possession of the Royal Geographical Society, is printed in *The Antarctic Manual*, pp. 305–25 (London, 1901).

[5] The compiler of the Notes on the Sandwich Islands, drawn up for the use of the Hydrographic Department of the Admiralty, calls attention to the curious circumstance that Brown was at Visokoi and Biscoe at Montagu on the same day (22 December 1830). They do not appear to have met.

[6] Larsen's report does not appear to have been published. The notes and extracts given here are from a translation prepared for the Colonial Office.

Larsen's landing on Zavodovski was adventurous enough. In his report he says:

> One of the boats was a pram, and I went on board that in order to try landing. In a manner we succeeded in this, but the heavy swell capsized the pram and threw us into the icy water, but on shore we came.... As the swell was on the increase we were obliged to put out the pram again, and we brought with us some stone samples. Then we rowed along the coast to the middle of the island just to where the fuming exhalations are to be found.... Here I went on board the pram again, as the swell was running too high to land with one of the other boats, but it was a risky affair. The pram shipped water before we could put on shore and all three were thrown into the icy water again. It was with great difficulty that we could save pram, oars, guns, etc. The pram capsized in the breakers, but we succeeded in getting it on shore without other damages than broken tholepins and a hole in the bottom. All the collection of stone samples from the first landing place were lost.

On shore Larsen became dizzy and was almost poisoned by fumes issuing from cracks in the ground, and though he succeeded in getting back safely to his ship he was seriously ill for some months. Of a number of the islands he made rough sketch-plans, and that these are not more accurate is due no doubt to the illness which overtook him after his first landing.

In 1911 the second German South-polar Expedition, under Lieut. W. Filchner, visited the northern islands of the group in the S.S. 'Deutschland'. The weather appears to have been bad and no survey work was attempted. Filchner, however, gives in his book[2] a description, a photograph and three sketches of Leskov. He notes that puffs of white cloud rose repeatedly from the summit, but was in doubt whether these were steam from a volcano or snow driven by the wind. Visokoi was sighted during a break in the weather and was determined as lying 6 to 8 miles S 55° E of its charted position. The Candlemas Group must have been passed at some distance, for Filchner, though giving a fairly accurate sketch, states that there is only a single island. Zavodovski was seen under better conditions; its volcanic activities are described and two sketches of it are given.

Shortly after the 'Deutschland's' visit, and in the same season, a small expedition set out to hunt whales in the vicinity of the islands. Mr H. Jensen, now Chief Engineer of the whaling transport 'Peder Bogen', who took part in the voyage, tells us that it was undertaken by two vessels under the command of Capt. Ole Jörgensen: a large whale catcher, the 'Thulla', with the barque 'Havfruen' in company. Four months were spent near the islands of which eight, apparently the eight southernmost, were seen. A landing was made in Ferguson Bay on Thule Island, and a barrel containing a notice of the visit was left on shore. The 'Havfruen' was damaged by ice and sank on December 1 1911, her crew being rescued by the 'Thulla'. The latter vessel afterwards operated on the Patagonian coast; but the voyage proved a commercial failure, as in the course of a year's work only twenty-eight whales were taken.

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[1] The geological specimens were reported on by Baeckström, *Bull. Geol. Inst. Upsala*, XIII, pp. 115–82 (1915), while some parts of the zoological collections (Isopods, Amphipods, Pycnogonids) are described by Miss Richardson, Chevreux and Bouvier in *Anal. Mus. Nac. Hist. Nat. Buenos Aires* (3), XIV, pp. 395–413 (1911).

[2] Filchner, *Zum Sechsten Erdteil*, p. 111 (Berlin, 1923).

Sir Ernest Shackleton[1] in 1914, in the auxiliary barquantine 'Endurance', passed between the Candlemas Group and Saunders, on his expedition to the Weddell Sea. Fifteen miles north-east of Saunders he met a belt of heavy pack-ice, and he notes that the position of this island, according to observations made by Cmdr. Worsley, is roughly 3 miles east and 5 miles north of its charted position.

In 1922 Cmdr. Frank Wild,[2] who was in command of the 'Quest' after Shackleton's death, paid a visit to Zavodovski. Like all others who have seen it he refers to its volcanic activity and speaks of caves on the southern side "from the mouths of which sulphurous fumes were issuing in a reddish cloud". With the help of Cmdr. Worsley a running survey was made of the island, and a reproduction of the chart has recently been published.[3]

In more recent years the islands have been visited on a number of occasions by vessels of the whaling fleet. Of these visits, as of that of Capt. Jörgensen, no published record appears to exist, but we have gathered some information regarding them from the managers of the whaling stations in South Georgia.

In 1927 the Tønsberg Whaling Co. sent one of their catchers to the islands to prospect for whales and to discover whether conditions suitable for a whaling factory were to be found. The catcher was the 'Busen VII', under the command of Capt. H. Hansen, accompanied by Lieut. B. Dingsör of the Norwegian Navy. A translation of Capt. Hansen's report has kindly been placed at our disposal by Capt. J. G. Andersen, Manager of the Tønsberg Co.'s station at Husvik in South Georgia.

The 'Busen VII' left Husvik on January 20. Course was set for Southern Thule, but when about 60 miles west of Montagu heavy drift ice was met. Capt. Hansen steered east, but found that Saunders was the most southern island that he could reach. Saunders itself was surrounded by a compact belt of ice, but by next day (January 25) it had drifted away. The report describes the bare hills at the southern end of the island, and mentions—for the first time—that the northern peak is volcanically active. There is a reference to a preliminary chart of the island, but this we have not seen; Holtedahl,[4] however, has published a sketch made by Lieut. B. Dingsör of the island seen from the north. The 'Busen VII' anchored for the night in Cordelia Bay. On January 26 she proceeded north to the Candlemas Group, where the existence of two islands with some rocks between was noted. Little time appears to have been spent at the group, for though the volcanic activity of the north-eastern island is mentioned, the report states that "no anchorage was found in the southern waters between the islands, and the soundings gave 90 fathoms without bottom".[1] The night was spent at Visokoi, the position of which is given as about lat. 56° 50′ S, long. 26° 55′ W, and here also volcanic activity was noticed. Visits were paid to Zavodovski on January 27 and to Leskov on the following day. On the return passage "a broad belt of ice-fields" was encountered in lat. 55° 17′ S, long. 32° 50′ W, but was penetrated after one hour's steaming and the vessel reached Husvik on January 29.

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[1] Shackleton, *South*, p. 5 (London, 1920).

[2] Wild, *Shackleton's Last Voyage*, pp. 85, 347 (London, 1923).

[3] *Rep. Geol. Collections made during the Voyage of the 'Quest'...in* 1921–2, p. 65 (British Museum, 1930).

[4] Holtedahl, "On the Geology and Physiography of some Antarctic and Subantarctic Islands," *The Norwegian Antarctic Expeditions*, 1927–8, 1928–9, No. 3, p. 102, fig. 44 (Oslo, 1929).

The 'Busen VII' reported that whales were plentiful, and, notwithstanding the lack of anchorages and fresh water, the Tønsberg Co. applied for a licence to work round the islands. In the following season (1927–8) they sent out the whaling factory 'Anglo-Norse'. Mr J. E. Hamilton, of the Discovery Committee's scientific staff, accompanied the expedition, and according to his report the 'Anglo-Norse' carried out most of her work in the shelter of pack-ice and far from any land. In the first half of the season she was to the north of the islands and in the second half to the south-east. Visokoi was once sighted at a distance of 30–35 miles, and it was noticed that a steady stream of white vapour was issuing from a small crater on the summit. On another occasion the vessel was within 12 miles of Southern Thule, but the land was not visible owing to fog and snow. The whale-catchers, however, naturally go further afield, and in one of these Mr Hamilton visited Bristol, Montagu and Southern Thule. In the last-named group

Table I.

		Capt. J. Cook, H.M.S. 'Resolution', 1775	Capt. F. G. von Bellingshausen, Corvettes 'Vostok' and 'Mirnii', 1819–20	Capt. J. Brown, Schooner 'Pacific', 1830	Capt. J. Biscoe, Brig 'Tula', 1830	Capt. C. A. Larsen, S.S. 'Undine', 1908	Lieut. W. Filchner, S.S. 'Deutschland', 1911	Capt. Ole Jörgensen, S.S. 'Thulla', 1911–12	Sir Ernest Shackleton, S.S. 'Endurance', 1914	Cmdr. F. Wild, S.S. 'Quest', 1922	Capt. H. Hansen, S.S. 'Busen VII', 1927	Whaling Factory 'Anglo-Norse' and catchers, 1927–8
Zavodovski		.	*	*	.	*	×	.	.	×	×	.
Leskov		.	×	×	.	×	×	.	.	.	×	.
Visokoi		.	×	×	.	×	×	.	.	.	×	×
Candlemas Group	Candlemas	×	×	.	.	*	×	×	×	.	×	.
	Vindication	×	×	.	.	.		×		.	×	.
Saunders		×	×	×	×	*	.	×	×	.	×	.
Montagu		×	×	.	×	*	.	×	.	.	.	×
Bristol		×	×	.	×	*	.	×	.	.	.	×
Southern Thule Group	Bellingshausen	×	×	.	.	×	.	×	.	.	.	×
	Cook		×	.	.		.	×	.	.	.	×
	Thule		×	.	.		.	*	.	.	.	×

× = Visited or sighted. * = Landing made.

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[1] As will be seen farther on there are several good anchorages in the Candlemas Group, and a 10-fathom channel between the islands.

he was able to verify the existence of the third island described by Bellingshausen, having steamed between it and Cook Island. The island was named after Bellingshausen, and two sketches of it, made by Mr Hamilton, are published in *The Antarctic Pilot* (1930).

In the following season, 1928–9, several whaling factories, including the 'Anglo-Norse', the 'Pelagos' and the 'Antarctic', operated for a time under the lee of the islands. During 1929–30 the whaling fleet has been working along the ice-edge, far to the south-east. A ship joining the fleet on a course from South Georgia would pass close to, or between the islands, which have thus been sighted on a number of occasions both by the whaling vessels and by their transports.

The first edition of *The Antarctic Pilot*, published by the Admiralty in 1930, contains a concise summary of our previous knowledge of the islands, and includes a number of sketches reproduced from Bellingshausen's Journal.

Omitting Morrell's discredited account, previous records of visits to the islands up to 1928 may be tabulated as on p. 143 (Table I).

ITINERARY

Leaving South Georgia fully bunkered on February 21 we almost immediately met with heavy weather, and on the 22nd the westerly wind reached the force of a full gale, with gusts of over 70 miles an hour. In very heavy seas the vessel shipped a good deal of water, sustaining some minor damage on board, and on the following day we were glad to find shelter under the lee of an enormous tabular berg. Here on the 24th plankton observations were made near the iceberg, and later that day and on the 25th, with much improved weather, we were able, as we had previously arranged, to take full series of observations at three points in soundings varying from 1785 to 1866 fathoms.

We reached Zavodovski on February 26, dredged on a bottom of scoria in 152 to 180 fathoms and anchored for the night under the lee of the island. For the following two days another gale, at least as violent as that four days earlier, blew from the west, and we were obliged to remain at anchor; but it eased on the evening of the 28th and on March 1 we made our running survey of the island and proceeded to Visokoi. Plankton nets were hauled the same evening, and next day we finished this survey and crossed to the Candlemas Group, taking full observations at a point midway between the islands in 840 fathoms. On the 3rd and 4th we were occupied in running surveys of the two islands of the group, completing them on the latter day just before the onset of a sharp blow from the north-east. On each of these nights we lay at anchor between the islands.

It was by now evident that there was a tolerably good prospect of surveying all the islands, and since pack-ice might arrive at any time from the south-west, Capt. Carey thought it best to go direct to the most southerly group. On March 5, therefore, we steamed to Southern Thule, where with great good fortune, we found the islands completely free of ice and with no indications of pack on the southern horizon. In good weather the survey of the three islands of the group was completed by March 8, in which time also we dredged and trawled off Cook Island in depths of 42 to 176 fathoms, landed on Thule Island, and in the deep basin between Cook and Thule ran many lines of soundings and made a series of observations on the plankton and hydrology. On the 9th we left for Bristol Island, taking another similar series of observations in 966 fathoms; but here fortune failed us, and for three and a half days we lay under the lee of the land in strong westerly winds. A trawl was taken in 10 to 44 fathoms. On March 13 the weather improved, Bristol was surveyed and we reached Montagu. Again delayed by westerly winds, we trawled in 54 to 88 fathoms on the 14th, made our running survey on the 15th and on the 16th crossed to Saunders Island. On the 17th Saunders was completed and the only remaining island was Leskov. We had found, however, when plotting our echo-soundings that some taken off Candlemas were curiously irregular, and wishing to check the work, we decided to call at the group on our way to the north. We reached Candlemas and verified the soundings on the evening of the 17th, and next day made our survey of the tiny island of Leskov, thus completing the entire group. We then turned to the south-west to take up the next deep-water station on our programme.

The actual work at the islands thus occupied twenty days, during six of which we were delayed by bad weather. Though sights of sun or stars were obtained at all the islands, dull weather was almost continuous, making it difficult to obtain good photographs. Temperatures were low throughout, and for a week, while at Bristol, Montagu and Saunders, the thermometer never rose above freezing-point.

DESCRIPTION OF THE ISLANDS

Position and extent. The South Sandwich Islands are situated between lat. 56° 18′ and 59° 28′ S, and long. 26° 14′ and 28° 11′ W, the northernmost of the group being about 290 miles E ½ S of South Georgia. In all there are eleven islands; ten of these form a curved chain stretching north and south, while one—Leskov—lies to the west of the line near its northern end. The chain is 193 miles in length and is concave to the westward. The largest of the group is Montagu, with a circumference of about 24 miles, and the smallest is Leskov with a circumference of about 1½ miles. There are two groups of islands: the Candlemas Group, consisting of Candlemas and Vindication Islands, and the Southern Thule Group, consisting of Thule, Cook and Bellingshausen Islands. Apart from these the islands are widely separated, the distances between them ranging from 24 to 41 miles.

The positions hitherto assigned to the islands on Admiralty charts are those given by Cook and Bellingshausen more than a century ago, and our survey testifies to the remarkable accuracy of their work. With modern instruments and wireless time-signals little alteration has been made. Differences are mainly in longitude, and as will be seen from Plate XI, our positions are frequently midway between those of Cook and Bellingshausen. The only exception is Visokoi, which Bellingshausen placed 8 miles north of its true position.

Pack-ice. During the winter, so far as is known, the South Sandwich Islands are completely surrounded by pack-ice from the Weddell Sea. The summer conditions vary greatly: in normal years the more northerly islands are probably free from ice for several months, but sometimes they are all unapproachable; and occasionally, in a season of unusual mildness, open water may surround the entire group.

The direction from which the pack-ice reaches the islands is not clear from the existing records. The set being north-easterly it would be expected that the western side would be the first to be closed in, and this is what Capt. Hansen found when he visited the group in 1927. Both Cook and Bellingshausen, however, found the western side open, and the latter at least, as his chart shows, met with heavy ice to the eastward. On the whole it seems almost certain that the pack generally arrives from the south-west, but that its local distribution about the islands may vary greatly in accordance with the prevailing winds.

Icebergs. Icebergs, both tabular and weather-worn, were plentiful at all the islands, and many of them were stranded near the shores. They were most numerous at Visokoi and to the north of the rocky islets lying to the west of Bristol, where nineteen were visible at one time. The number of black bergs, carrying mud and stones from the moraines of the glaciers where they were formed, was unusually large during the season 1929–30. Three of the nineteen referred to above were of this type, and later, in the seas to the west of the islands, many more were observed. These bergs are invariably particoloured, one portion being black and the other white, and it is noteworthy that almost without exception there is a sharp and perfectly straight line of demarcation between the black and the white: the black portion is always completely black and quite opaque. There is in addition another type of berg, of which a good example was seen at Visokoi. This is in most respects closely similar to the morainic type, and at a distance may easily be mistaken for it; but on near view it is found that the black is replaced by a very dark but translucent bottle-green colour. This dark green part, like the black of the morainic bergs, is always smoothly rounded by water action, pointing to the probability that it was originally on the underside. We have, however, seen to the north-east of the South Orkneys a stratified and tri-coloured berg, in which the lower part was black and the upper dark green, with a narrower middle layer of pure white. We are unable to suggest how these dark green bergs are formed, and have not found any reference to them in the literature at our disposal. Priestley, in his valuable account of Antarctic icebergs,[1] mentions neither the morainic nor the dark green types, and from this, as well as from Dr E. H. Marshall's personal experience in the whaling factory 'C. A. Larsen' in 1928–9, it appears that such bergs are either absent from the Ross Sea or are extremely scarce.

No very large tabular bergs were seen round the South Sandwich Islands, but one with an estimated length of over 60 miles was met on our passage from South Georgia: we rode out a full gale of wind in comfort under the lee that it afforded. Bergs with narrow bands of hard blue ice were seen on one or two occasions.

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[1] Priestley, "Glaciology", *British Antarct.* ('*Terra Nova*') *Exped.* 1910–13, pp. 402–17 (1922).

Wind and set. The current in the Southern Ocean from lat. 50° to 60° S and long. 24° to 42° W has proved to be north-easterly and approximately 12 miles per day: it is constant and can be depended upon. The prevailing winds are north-west and south-west; both blow with violence, the former coming with a falling barometer and the latter when it is rising. As a rule neither blows for more than four days and is immediately followed by the other. Swell and sea rise very quickly. At the South Sandwich Islands the wind was mainly north-west or south-west, but sometimes it blew from the north-east, bringing fog and mist.

Contrary to that experienced at South Georgia the set round the islands is clockwise. This we attribute to the trend of the coast-line, which bears more north and south than at South Georgia, thereby deflecting the usual north-easterly set to the northward and giving a clockwise motion. At the Candlemas and Southern Thule Groups, where two or more islands lie close together, a strong southerly set of about 1 knot was experienced in the channels between them (Nelson and Douglas Straits).

Magnetic variation. The opportunity of swinging ship for magnetic variation occurred but once during our survey, and then, though taken advantage of, was not as thorough as we might have wished. This was at Montagu, when, during a short clear period between snowfalls, we swung (to port only, unfortunately) and took observations for compass error on 16 points. We obtained a variation of 10° 31′ W, and think this may be taken as fairly accurate, though the continual rolling of the vessel made observation rather difficult.

Local attraction. Compasses were adjusted on February 21 when leaving South Georgia, and with observations made when the ship was steady, the standard compass showed little or no deviation. Later on, under similar conditions at the South Sandwich Islands, and allowing the variation given on chart no. 3775, it was likewise found that little or no deviation still existed. This, we consider, may be taken as evidence that magnetic conditions are quite normal. At no time was any local attraction observed.

Wireless time-signals. Reception of wireless time-signals was found to be very good at all points in the group with the exception of Bristol and Southern Thule. Signals received were mainly from Washington, but Nauen was heard on one or two occasions.

Anchorages: Landings. The islands are without harbours, but at most of them there are anchorages where a vessel may obtain some shelter. The best is Ferguson Bay in Thule Island, but since this is in the extreme south it will very often be inaccessible on account of ice. The next best are in Nelson Strait in the Candlemas Group; in these protection from any wind can be obtained and they are much more likely to be free of ice during the summer months. Even in the finest weather there is a heavy swell and the coast is generally precipitous and rocky: where beaches exist they shelve steeply and there is a strong undertow. As a consequence landings can only be made with difficulty, and on some islands they are probably impossible. Water could no doubt be obtained on any of the group by melting snow or ice. Owing to volcanic heat the ground on some of the islands is warm, and on one—Vindication Island—small streams from the melting glacier run down to the shore.

Soundings. Most of the soundings taken in shallow water during the course of our running surveys are shown in the plates accompanying this report, and some reference is made to them in the descriptions of the individual islands. An interesting feature revealed by these inshore soundings is the existence of a deep basin, formerly a volcanic crater, between two of the islands in Southern Thule (see p. 179).

The depths between the islands have not been investigated with any thoroughness, but soundings of 589, 774 and 840 fathoms were taken between Visokoi and Candlemas, of 681, 721, 966 and 1062 fathoms between Bellingshausen and Bristol, and 499 and 822 fathoms between Montagu and Saunders. More recently a continuous line of soundings, taken across the bank between Candlemas and Saunders, showed a minimum depth of 1196 fathoms. These depths are all considerably less than those of the seas surrounding the islands: to the west is a basin with over 2000 fathoms and with more than 3000 fathoms in its centre, while in the east the mean level of the Southern Ocean is found at depths of more than 2500 fathoms. It is thus evident that the islands are connected by a low submarine ridge.

The relief of the ocean floor in the neighbourhood of the islands presents features of considerable interest. To the north of the group very deep soundings have been reported by the 'Deutschland' and by the 'Meteor', the former vessel having found 3068 fathoms[1] (lat. 54° 27′ S, long. 31° 7½′ W) and the latter 3664 fathoms[2] (lat. 55° 12′ S, long. 29° 13′ W) and 4402 fathoms[3] (about lat. 55° S, long. 28° W). At the time it was taken the last of these was the deepest sounding known in the South Atlantic. Immediately to the south of these great depths geological theory of former land connections postulates the existence of a shoal or bank linking the South Sandwich Islands with South Georgia, and one or two of the few soundings taken in this area seemed to show that such a bank might be found.

In 1931, the succeeding season to that in which the islands were surveyed, we were able to take a number of lines of echo-soundings, and though much still remains to be done we believe that the principal features in the topography of the region are already apparent. The results are shown in the chart in Fig. 3, which indicates the approximate positions of the 1000 to 4000 fathom contours. It will be seen that the South Sandwich Deep has been traversed at three points, and we are able to prove that it extends round the eastern side of the islands far to the south of the position in which it was first discovered. Probably it is continued as far as the Thule group, but its southern limits have not yet been determined. We have in all fourteen soundings which exceed 4000 fathoms, the greatest being 4421 fathoms. We are also able to show with some precision that a connection, in the form of a narrow ridge, exists between the South Sandwich Islands and South Georgia, and it seems probable that the greatest depth on this ridge does not exceed 1500 fathoms.

The line of echo-soundings between Candlemas and Saunders Islands passes through the widest gap between any two islands of the group. The line was continued to the

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[1] Brennecke, *Arch. Deutschen Seewarte*, XXXIX, p. 97, St. 52 (1921).

[2] *Zeitschr. Ges. Erdkunde Berlin*, Jahrg. 1926, p. 234.

[3] *Loc. cit. supra*, pp. 225, 274.

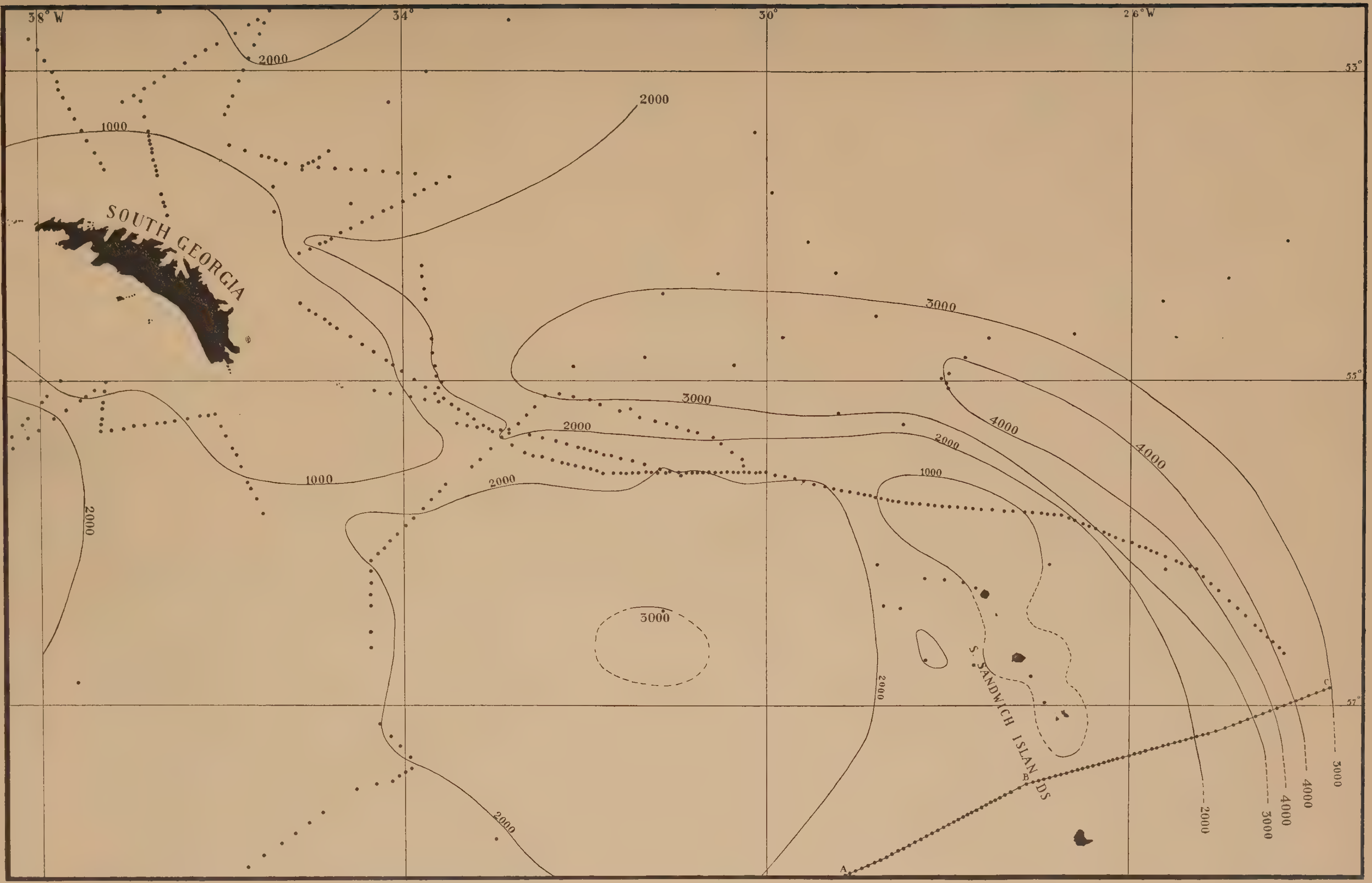
38° W
34°
30°
26° W
53°
55°
57°
SOUTH GEORGIA
S. SANDWICH ISLANDS
A
B
C
1000
2000
3000
4000

Fig. 3. Chart of South Georgia and the northern islands of the South Sandwich group, showing the approximate positions of the 1000–4000 fathom contour lines. The black dots show the positions where soundings have been taken. The section in Fig. 4 passes through the line marked A, B, C.

east until the deep had been crossed, and a section plotted from the data obtained is shown in Fig. 4. It will be seen that the ocean bed to the west slopes gently upwards, with some irregularities, from depths of 1880 or 1900 to about 1600 fathoms, and then rises very sharply to a minimum at 1195 fathoms. In the position where the section was taken the ridge on which the islands stand has two crests and its breadth is only fifteen miles. On the eastern side of the ridge there is no abrupt declivity; the bottom, however, falls more steeply than in the west to a depth of over 2000 fathoms and then plunges to the bottom of the deep, which has here a depth of over 4250 fathoms. Farther to the east the bottom rises as abruptly as it fell, until the mean level of the southern ocean is reached at under 3000 fathoms. Where cut by our section the deep has a width of only some twenty miles.

Origin. It is evident that the entire group owes its existence to volcanic disturbance. The rocks, composed mainly of reddish tuff and black basaltic lava, are closely similar throughout the group; and in five of the islands there is still volcanic activity in the form of steam clouds and sulphur fumes. That this chain of volcanoes is bordered by one of the ocean deeps is significant, and it is a feature which is paralleled in several other parts of the world.

Volcanic activity. We found, as others have done before us, that it is not always an easy matter to determine whether steam is or is not rising from a particular island. The summit is usually wreathed in cloud or mist, which as it clears may assume deceptive forms, and powdered snow carried by gusts of wind may bear an amazingly close resemblance to steam arising from a fissure. We think, however, after examining each island closely, that the present state of volcanic activity in the group may be summarized thus:

I. *Islands showing definite activity, emitting vapours and fumes.*

Zavodovski. Main crater, emitting dense clouds of steam and vapour, near top of snow-clad summit. Plateau on southern and eastern sides not glaciated and largely devoid of snow, with small craters and fissures, some of which also are active. Strong sulphurous fumes detected.

Candlemas. Southern part with its three snow peaks heavily and completely glaciated. Northern part a plateau of lava from which arises a hill with large crater at top. Another crater at base of this hill a little above sea-level. Plateau and hills entirely devoid of snow. Both craters active, emitting strong sulphurous fumes.

Bellingshausen. A large crater at summit and fissures on south side of cone, with steam and vapour rising from both. Entire island without glacier, but with patches of snow.

Saunders. Greater part of island heavily glaciated, with snow-clad cone ending in a crater from which clouds of steam arise. South-eastern end of island with little or no snow and with two extinct craters.

Visokoi. A heavily glaciated cone, with clouds of steam arising from near its summit and from a fissure on the steep north-western slopes.

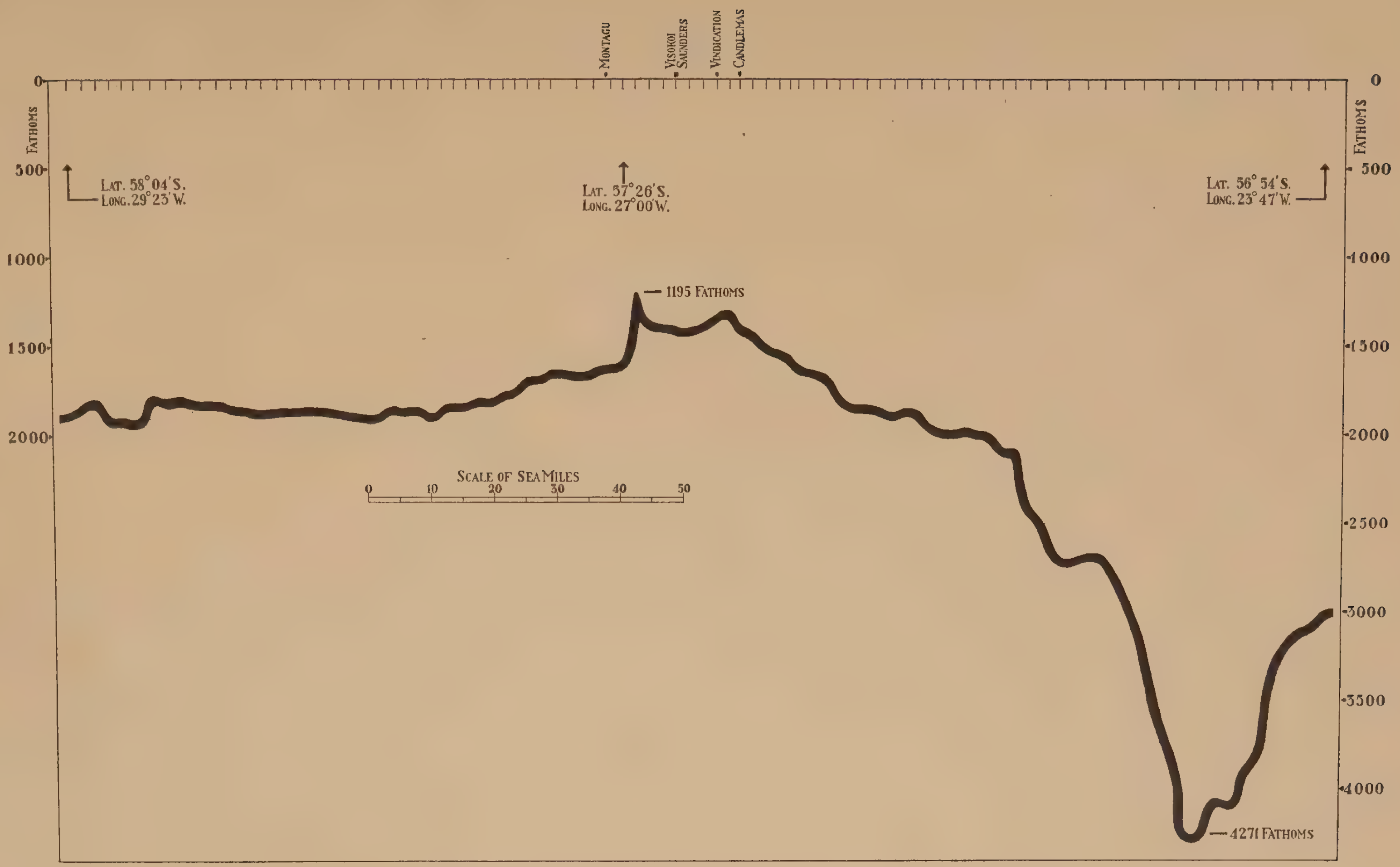

Fig. 4. Section across the South Sandwich bank and South Sandwich Deep.
The section is based on 88 echo-soundings and is nearly 200 miles in length; it passes between the Candlemas group and Saunders I. on the line marked A, B, C in Fig. 3. The positions of some of the neighbouring islands are shown above the line representing the surface; below it are shown the positions at which soundings were taken. Vertical scale exaggerated 28 times.

II. *Islands without activity, but showing evidence of warmth.*

Leskov[1]. Apparently only a portion of a pre-existing crater. Probably not now active, but with no glacier and little snow.

Vindication. Thinly glaciated on higher slopes: extensive areas without snow.

Montagu. Greater part of island and summit deeply glaciated, but with patches of bare ground and indications of melting snow on and near peak at south-eastern corner.

III. *Glaciated islands showing no signs of warmth or activity.*

Bristol. Cook. Thule. Very heavily glaciated throughout, the glacier at sea-level reaching an average thickness of 200 ft.

During our visit all the volcanoes were quiescent, and the conditions appear to suggest that the volcanic activity is slowly abating: no eruptions were witnessed, nor was any glow from the craters visible at night. We think it likely, however, that eruptions may still occur from time to time on Zavodovski and Candlemas. This may also be true of Bellingshausen; but Visokoi and Saunders appear to be in the solfatara phase, their activity being limited to the emission of steam and vapour.

Mode of formation. There is clearly a tendency on some of the islands for volcanic activity to cease at one point and to break out at another. Thus the northern end of Candlemas, now the only active part of the island, appears to be a more recent formation than the high and heavily glaciated southern end. In the Southern Thule Group, Cook and Thule Islands, with the submerged crater between them (see p. 179), are extinct, the outlet for volcanic activity having shifted to Bellingshausen. In Montagu also, only the small cone at the south-east corner, probably the most recently formed part, still shows traces of warmth. Saunders is a less simple case. The high glaciated cone of Mt Michael is still active; but to the south-east there are craters formed of volcanic mud or ash, seemingly extinct, but with most of the ground bare of snow and evidently still warm. It may perhaps be surmised that the main crater was extinct for a period, during which the south-eastern outlets were in operation, and that later it resumed its activity.

If these suppositions are correct the mode of formation of most of the islands is tolerably evident. For Zavodovski, Visokoi and Bristol retain their original character of simple volcanic cones, and Leskov is probably a fragment of what was once a crater. The only island that presents difficulties is Vindication; for it seems certain that it does not represent the whole of a cone, and the soundings we have taken do not afford any clue to the way in which it was formed.

In its original form each island would appear to have consisted of a circular plateau of basalt, with a central cone formed of alternate layers of tuff and ash—a condition most nearly realized in Zavodovski. As a result of the prevailing westerly winds abrasion is most active on the western aspects of the islands, while lighter materials from volcanic eruptions are deposited to the east: thus, in most of the islands, it is on the western side that we find the steepest cliffs and the deepest off-shore soundings.

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[1] This island was partly covered with mist during almost all the time it was under observation.

Glaciation. The islands and portions of islands that have lost all volcanic warmth are buried deep in glacier, and ice also covers the still active cones of Visokoi and Saunders. This ice-cap is similar in type to that commonly seen on Antarctic islands, but it conforms to the larger irregularities of the surface and rarely shows the perfectly even shield- or dome-shaped contour which characterizes the full development of this form of glaciation (Plates XXIII, XXV, XXIX). The ice, however, may reach a thickness of as much as 260 ft. at its coastal margin. Rocks outcropping through the ice-cap were seldom seen, and there were no bergschrunds; but not infrequently a crevassed protrusion in the glacier spoke of projecting rock beneath. The action of the ice is evidently to abrade and reduce surface inequalities, rather than to emphasize their relief as in mountain glaciers.

The term "ice-cap" is used here in the sense defined by Hobbs[1] and seems very appropriate to this form of glaciation; but in Priestley's more recent classification of land-ice formations[2] it has been abandoned and is replaced by "island-ice" and "highland-ice". The first of these is applied when the contour is perfectly even, and the latter when the conformation of the underlying land is not completely obscured. The difference between the two does not appear important, for it depends merely on the amount of relief in the land surface and the thickness of the glacier. An island with high hills and very thick glacier might still be "highland-ice", while one of low ground might be "island-ice" though its covering were very thin. In their denuding processes and in their alimentation[3] the two appear to be indistinguishable.

A type of glaciation agreeing with that in the South Sandwich Is. has been described by Holtedahl[4] from Bouvet and from some of the islands in the South Shetlands and Palmer Archipelago. Holtedahl considers that Priestley's definitions of "island-ice" and "highland-ice" do not accord with these formations and he has therefore proposed a new term, "the Antarctic ice-mantle type".

We prefer here to use "ice-cap" in the sense employed by Hobbs without attempting any finer classification, but we should perhaps point out that this term is not universally applicable to island ice-formations in the Dependencies of the Falkland Is. In some of the islands of the South Shetlands and Palmer Archipelago—Low and Snow Is. are examples—the land is covered with a smooth evenly-domed shield of ice, without any irregularities due to the underlying rock, while in others the formation is closely similar to that found in the South Sandwich Is. For both these we may use the term "ice-cap", and in the first of them it is seen in its most perfect development. But there are other islands, including all the largest, which are entirely different. In these the "ice-cap" exists only as a fringing or foreland glacier, through which protrude hills and mountain ranges with steep escarpments, and surrounded by a bergschrund. It is clear that this type of glaciation is a combination of ice-cap and mountain glacier, for denudation is proceeding by two quite different methods. In the foreland, by plucking and by erosion, all irregularities have been smoothed away, whereas farther back the ice is cutting into the hill-ranges and in so doing tends always to sharpen the existing relief.

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[1] Hobbs, *Characteristics of Existing Glaciers*, pp. 7, 8, 285, 286 (New York, 1922). First published in 1911.

[2] Priestley, "Glaciology", *British Antarct.* ('*Terra Nova*') *Exped.* 1910–13, pp. 147, 148 (1922).

[3] It is these characters that Hobbs uses for his primary division of land-ice formations into "inland ice", "ice-cap" and "mountain glacier".

[4] Holtedahl, "On the Geology and Physiography of some Antarctic and Subantarctic Islands", *The Norwegian Antarctic Expeditions*, 1927–8, 1928–9, No. 3, pp. 121, 122 (Oslo, 1929).

Geology. It was thought by Suess, and is maintained by many geologists, that the chain formed by the Burdwood Bank, South Georgia, the South Sandwich Islands and Graham Land (sometimes known collectively as the South Antillean Arc) represents an extension of the folds of the Andes, curving eastwards into the Atlantic. Gregory, on the other hand, considers that so far as South Georgia is concerned this view is untenable and from the evidence afforded both by its igneous and sedimentary formations he[1] concludes that South Georgia is "a fragment of an ancient South Atlantic Land, and the south-western corner of the *Flabellites*-land of Schwarz", in no way related to the Andean system. Tyrrell,[2] however, has confirmed Nordenskjöld's view that the eruptive rocks of Graham Land and the South Shetlands are completely identical with those of the Andes, and Holtedahl,[3] more recently, has contested Gregory's views on the relationships of the rocks of South Georgia. The echo-soundings that we have taken during the last two years show conclusively that most of the submerged portions of the arc claimed by Suess can still be traced in the relief of the sea-bottom.

In these circumstances the geological structure of the South Sandwich Islands should be of some interest; it is a matter for regret that our lack of knowledge precluded field observations of real value, and that owing to the difficulty of making landings rock samples were obtained only on Thule Island. The specimens from this island, collected by Mr T. J. Hart, have, however, kindly been examined by Dr Tyrrell and his report is published as an appendix to this paper (p. 191). From microscopic examination and chemical analyses Dr Tyrrell has reached the important conclusion that the South Sandwich rocks are typical Andean lavas—a fact which goes far to support Suess's theory.

So far as we were able to observe, the islands themselves are all composed of eruptive rocks; but Freezeland Peak, situated to the west of Bristol Island, differs conspicuously from anything seen elsewhere. From a geological point of view this islet appears to be of considerable interest, for if our view is correct, it is here alone that an exposure of the underlying sedimentary rocks is to be found. To effect a landing on Freezeland Peak would be extremely difficult, but it might not be impossible in exceptionally good weather.

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[1] Gregory, "The Geological History of the Atlantic Ocean", *Quart. Journ. Geol. Soc.*, LXXXV, p. cxi (1929). See also *Nature*, CXXVI, p. 837 (1930).

[2] Tyrrell, *Trans. Roy. Soc. Edinburgh*, LIII, p. 78 (1921).

[3] Holtedahl, *loc. cit. supra*, pp. 104–11.

It is probable that the volcanic eruptions gave rise to the South Sandwich Islands in late Tertiary or early Quaternary times. This is the age attributed to the later eruptive rocks of the South Shetlands and Graham Land.

Seals. Only three species of seal were identified at the South Sandwich Islands. The most abundant was the Leopard seal (*Hydrurga leptonyx*), which was very frequently seen in the water, especially in the neighbourhood of penguin rookeries. In our attempts to make landings we were often closely followed by these seal, which would come up from behind to within a few feet, raise their heads from the water to look at us and then swim alongside or dive underneath. In a small boat the manœuvres of these large animals may be a little disconcerting; but their motive is only curiosity, though it may sometimes lead them, as we are informed by the whaling managers at South Georgia, to lift their heads from the water on to the gunwale. The Leopard seal, as Matthews has noted,[1] does not congregate in rookeries on shore like some other species, and for this reason it is unlikely that it can ever be taken in sufficient quantity for commercial purposes. At several of the islands one or two were seen hauled up on shore.

The islands as a whole are very deficient in places where seal can form rookeries, and even where beaches exist which appear suitable no great numbers were seen. The best beaches are on Candlemas Island, in Cordelia Bay on Saunders Island, and near Beach Point on Thule Island. Those on Candlemas were not examined closely, but appeared to have very few seal on them. At Thule Island a landing was made, and Dr Marshall reports that the seal here, about forty-five in all, were mainly Weddell seal (*Leptonychotes weddelli*). About the same number was seen on Saunders Island and these in all probability were mainly Weddell seal also, though it was difficult to identify them with certainty from a boat. Three Weddell seal were seen at Montagu Island, two on the rocks and one on an ice floe.

Elephant seal (*Mirounga leonina*) can be distinguished with more certainty, but were only seen in very small numbers: about six on the eastern side of Visokoi, one on Vindication, perhaps a dozen in Cordelia Bay on Saunders, and two near Beach Point on Thule. The existence of Elephant seal must have been known to the sealers who visited the islands during the last century, but the species does not appear to have been previously recorded from the group and it is not mentioned in Larsen's report. It occurs in some abundance in the South Orkneys and in former times is said to have been found in the South Shetlands. At the South Sandwich Is. there is a complete absence of the tussac grass among which it forms rookeries at its headquarters in South Georgia, and this, combined with the unsuitable foreshore and the fact that the islands are very near the southern limit of its range, must be held to account for its scarcity.

No Crab-eater seal (*Lobodon carcinophagus*) were recognized with certainty, though some at Cordelia Bay may have belonged to this species. We saw no Fur seal (*Arctocephalus australis*), and Larsen, who made landings on a number of islands in order to look for them, reports that he found none. It appears, however, that Fur seal must at one time have inhabited the islands, even if they do not still do so, for Larsen stated in 1918[1] that American sealers once took 300 at the Sandwich Group.

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[1] Matthews, "The Natural History of the Elephant seal, with notes on other Seals found at South Georgia", *Discovery Reports*, I, p. 253 (1929).

Whales. In recent years considerable numbers of Blue and Fin whales have been taken near the South Sandwich Islands, but in 1929–30 no whalers were working in the neighbourhood. At South Georgia and the other islands of the Falkland Dependencies, whales—especially Blue whales—tend to be scarce in mild seasons when there is little ice about. The catches at the South Georgia shore stations during this season were much below the average, and the vessels of the pelagic whaling fleet were mostly operating far to the east of the South Sandwich Group. A few whales, apparently Fin whales, were sighted near the islands; but Black-fish (*Globicephala*) and Black and White dolphins (*Cephalorhynchus*), both seen in the same season in South Georgia, were not observed.

Birds. Birds are numerous on the islands. Penguins are especially abundant and have built their rookeries in almost every suitable place. They will not nest on the glacier itself, nor, doubtless because of the danger of falling ice, on the beaches beneath it. In consequence they find much difficulty in establishing themselves on the more heavily glaciated and precipitous islands: on some, such as Thule and Bristol, there are only one or two small headlands which they can occupy, and they appear to be altogether absent from Cook and Leskov. On islands where the warmth of the rock has melted much of the snow they are particularly abundant, and on Bellingshausen it was noticed that small groups had climbed the steep slopes of the cone, ascending almost to the edge of the crater and to a height of at least 450 ft. above sea-level.

The Antarctic or Ringed penguin (*Pygoscelis antarctica*) is much the commonest species, and Dr Marshall, who landed near a small rookery on Thule Island on March 7, tells us that he found the young birds shedding their down coats. Gentoo and King penguins (*Pygoscelis papua* and *Aptenodytes patagonica*) were seen on Zavodovski and Saunders Islands. They probably occur on other islands also, but even with powerful glasses it was difficult to identify the species of penguin from on board ship. Those frequently seen on icebergs were invariably *P. antarctica*. Capt. J. Brown, who landed a party on Zavodovski in 1830, reported that his men found five different species of penguin, but he does not give their names. On this island Larsen found the Macaroni penguin (*Eudyptes chrysolophus*) in addition to those mentioned above. The Adélie penguin (*Pygoscelis adeliae*) probably occurs, but was not recognized with certainty. Mecking's statement[2] that the Emperor penguin (*Aptenodytes forsteri*) occurs at the islands in large numbers is certainly incorrect.

The Cape pigeon (*Daption capensis*), known to some of the early voyagers as "the Spotted Eaglet", is extremely abundant at most of the islands, but seemed to be less common at the Southern Thule Group. Very frequently it was seen flying or swimming with the Silver-grey fulmar (*Priocella glacialoides*), which is equally numerous. Both species were seen in thousands perched on ledges on the steep cliff sides, and we think it certain that they nest on the islands.

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[1] *Report of the Interdepartmental Committee on Research and Development in the Dependencies of the Falkland Islands*, Cmd. 657, p. 92 (1920).

[2] Mecking, in Nordenskjöld and Mecking, "The Geography of the Polar Regions", *Amer. Geogr. Soc., Special Publication*, No. 8, p. 318 (New York, 1928).

Another species common at many if not all the islands is a tern, doubtless a form of *Sterna vittata*: small flocks were frequently seen sitting head to wind on an iceberg in company with Antarctic penguins. The Giant petrel (*Macronectes giganteus*) was sometimes numerous, but the Shoemaker (*Majaqueus aequinoctialis*), a skua which appeared to be identical with that at South Georgia (*Catharacta lönnbergi clarkei*) and the Dominican gull (*Larus dominicanus*) were less common. Wilson's petrel (*Oceanites oceanicus*), a most abundant bird at South Georgia, was here very scarce, and Whale birds (*Prion* sp.) were seen only on a few occasions. A Shag (*Phalacrocorax atriceps*) was observed at the Candlemas Group, and a large flock of them was constantly around us while at anchor at Bristol Island. A single Mollymauk (*Diomedea melanophrys*) was seen at Saunders. Other Albatross (*Diomedea exulans* and *Phoebetria*), the Snow petrel (*Pagodroma nivea*), the Diving petrel (*Pelecanoides urinatrix*) and the Sheath-bill (*Chionis alba*) were not seen at all. In the nesting season other birds are doubtless to be found at the islands: Larsen reports that in November he saw thousands of *Pagodroma nivea* nesting with *Daption* on Leskov.

Fish. At most of the Dependencies of the Falkland Islands fish may be caught very readily with hand-lines or in traps: on some occasions near King Edward Point in South Georgia several hundred have been taken in the course of an hour or two. At the South Sandwich Islands we were very unsuccessful in obtaining fish. Frequently nothing whatever could be caught, and the only anchorage where even moderate numbers were taken was off Shrove Point, Candlemas I. The fish were all *Notothenia rossi*, the common species at South Georgia, or an extremely closely allied form. The few trawls which were taken yielded only a small number of fish; the commonest was *Parachaenichthys georgianus*, but at Bristol a small species, *Notothenia angustifrons*, was obtained in some quantity. At most of the places where trial was made the ground was thickly covered with large simple Ascidians (*Ascopera* and other genera); of these many hundredweight were brought on board and among them numerous interesting zoological specimens were obtained.

Vegetation. Tussac grass (*Poa flabellata*), which grows so luxuriantly at South Georgia, does not occur anywhere in the South Sandwich Islands. On almost all of them, however, patches of green vegetation may be found, occurring rarely and nearly always on a penguin rookery, where the ground is well manured. Cook mentions two hills, seen beyond the north point of Saunders Island, which were without snow and "seemed to be covered with a green turf". The hills must be those at the southern end of Cordelia Bay, which are bare and formed of volcanic ash or mud, but at the time of our visit there was no vegetation on them—nor was there any extensive rookery of penguins. It was on Zavodovski, on steeply sloping ground on the northern side, inhabited by vast numbers of penguins, that the most abundant vegetation was to be seen, and here it certainly resembled green turf. The only specimens we have are some collected on Thule by Mr T. J. Hart, and these have kindly been identified for us by Mr

G. Tandy as *Prasiola crispa*, a species of green alga also known from the Arctic and from the temperate regions of Europe, Asia and Africa. It is possible, though we think it unlikely, that the green patches on some of the other islands belong to a different species.

That there are other forms of vegetation on the islands was evident; on two at least, Leskov and Vindication, lichens grow in some abundance. The unicellular alga, *Chlamydomonas*, which forms "red snow", was observed on a number of islands, probably occurring on all, and samples were collected on Thule.

In our trawls and dredges we obtained several kinds of red and brown sea-weed, but kelp, *Macrocystis pyrifera*, was not found, and its complete absence from the islands is a noteworthy feature. At South Georgia kelp grows luxuriantly along the shores and on all reefs, even far out at sea: its fronds, floating on the surface, are a most valuable aid in navigation. At the South Orkneys kelp also occurs, but less abundantly, while in the South Shetlands it appears to be absent. Growing kelp is known to be cut away by ice, but at the South Sandwich Islands it is unlikely that all could have been removed by this agency, especially in an unusually mild season.

ZAVODOVSKI ISLAND

Lat. 56° 19½′ S, long. 27° 34½′ W

(Plates XII and XIII; Fig. 5)

This island is about 9 miles in circumference and is nearly circular in outline. A single peak, the cone of a volcano, lies a little to the south of its middle point and according to our observations is 1600 ft. in height.[1] On the western side the coast is precipitous, with sheer cliffs falling abruptly to the sea, but from the north to the south-east there is a low-lying plateau rising gently to the base of the cone.

To the west and north-west the water is deep, with 50 to 100 fathoms close inshore, but on the east and south-east sides soundings of 14 to 20 fathoms may be obtained at less than a mile from the coast, with good holding ground on a bottom of scoria and boulders. Owing to the shape of the island the swell carries round and it is necessary to shift berth as the wind changes.

Seen from the east, with the summit bearing 242°, the island rises as a central cone from a plateau extending far to both right and left (Plate XIII, fig. 1; Fig. 5 *c*). The cone from this point of view is snow-covered and during our visit its apex was largely obscured by clouds of steam and vapour issuing from the crater. When these clouds drifted aside it was possible to see two dark streaks diverging downwards from the lip of the crater—evidently fissures in which the snow cannot lie owing to the warmth of the ground. The fissure on the southern side is short and curved; the other is much longer, and, with some sharp angular turns in the middle of its course, extends downwards for about two-thirds the height of the cone. It is perhaps to this long fissure that Bellingshausen alludes in an obscure passage in his narrative, which reads (as translated): "the

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[1] Bellingshausen gives the height as 1200 ft., Brown as 800 ft., Filchner as 350 m. (= 1150 ft.), while Wild states that it is "not more than 3500 ft."

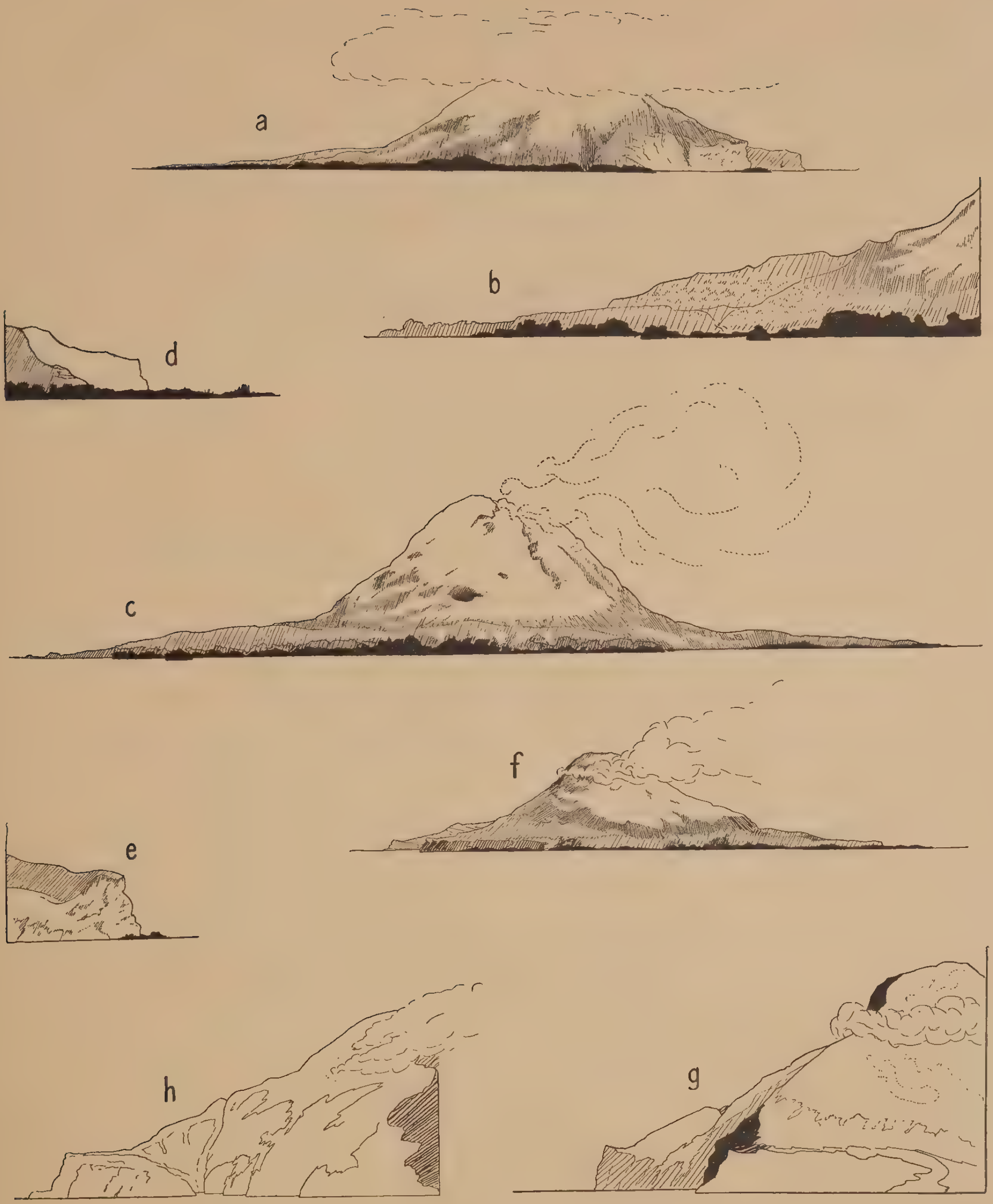

Fig. 5. Zavodovski Island: sketches by Lt.-Cmdr. J. Irving.

a. From the NE: summit bearing 222°, distant 6 miles.
b. S end of the island seen from the E: south point bearing 251°, distant 1·4 miles.
c. From the E: summit bearing 242°, distant 2·2 miles.
d. West Bluff seen over Low Point; the latter bearing 205°, distant 6 cables.
e. West Bluff from the NNE: bearing 195°, distant 1·3 miles.
f. From the S: summit bearing 021°, distant 2·2 miles.
g. West Bluff from the S: bearing 346°, distant 2·5 miles.
h. Another view of West Bluff from the S: bearing 000°, distant 2 miles.

mountain, with sloping sides, in the middle of the island had the appearance of two Latin 'SS' placed side by side".

On the lower slopes of the cone several dark patches were conspicuous (Plate XIII, fig. 1, and Fig. 5 *c*) and two of these, seen by telescope, were found to be funnel-shaped cavities. They are no doubt subsidiary craters, but did not show any sign of activity. The plateau, owing to the warmth of the ground, is free from snow, except for some patches close to its seaward margin: it is black, with its surface apparently composed of volcanic ash or scoria. The plateau ends abruptly in low cliffs 30 to 40 ft. in height, with outlying rocks: all are of black basaltic lava, sculptured and eroded by wave action, and with deep vertical fissures and gullies up which the surf runs with every swell. Many penguins were to be seen on this plateau and a brownish band near the edge probably marks the position of their rookery.

Where the plateau ends at the south side of the island (Fig. 5 *b*) is another penguin rookery on which some patches of green vegetation were to be seen.

To the west the ground rises sharply and extends to the northern end of the island as sheer cliff or very steeply sloping hillside, all entirely free from snow (Plate XIII, fig. 2). The main crater is immediately above West Bluff (Plate XIII, fig. 3; Fig. 5 *g*, *h*) and so far as could be seen through the dense clouds of steam and vapour that it emitted, its western edge is broken away, so that it opens obliquely below the highest point of the island. A little to the south of West Bluff fumaroles are to be seen on the steep hill-side, and the ground here is mostly reddish in colour with some patches and streaks of sulphur. At one point horizontal strata were exposed, consisting apparently of alternate layers of tuff and ash, the former thicker than the latter. Green staining was seen at one place.

On the northern slopes there is a rookery with many thousands of penguins, and here the most extensive patches of green vegetation seen in the islands were observed. The plant is almost certainly the same alga that we collected on Thule Island, but it is so luxuriant that, as Cook said of Saunders Island, it greatly resembles green turf.

The volcanic activities of this island have been noted by all who have visited it, and the strong sulphurous fumes which swept across us as we lay at anchor 6 cables from the shore were also remarked upon by Bellingshausen, Larsen, Filchner and Wild. Apart from the main crater and the fumaroles on the steep western slopes, a great part of the lava plateau on the east and south-east sides appears to be active, with vapour and fumes issuing from cracks and crannies in the ground. Wild mentions caves on the southern side, "from the mouths of which sulphurous fumes were issuing in a thin reddish cloud". Larsen says that on landing he found

> it was almost intolerable on account of the very hot sulphur and other poisonous fumes, which were blown out now and then with such force, that small stones were thrown a long way out of innumerable small holes and cracks in the ground. The fumes were so hot that one could not hold the hand over the holes without burning it. The air was quite poisoned, so that I turned dizzy, and I am of opinion that nobody could stay there very long without being poisoned. Pure sulphur was flowing out of some cracks and the whole shore was composed of layers of it mixed with soft material from the interior of the island.

There are three records of landings on the island: by Bellingshausen, Brown and Larsen.

LESKOV ISLAND

Lat. 56° $39\frac{3}{4}'$ S, long. 28° $10\frac{1}{4}'$ W

(Plates XIV and XV, fig. 1; Fig. 6)

Leskov, which lies some distance to the west of the arc formed by the other islands, is the smallest in the South Sandwich Group. Its size has been over-estimated by those who have previously visited it, for it is only $5\frac{1}{2}$ cables in length, in the middle scarcely 3 cables in breadth, while its circumference is about $1\frac{1}{2}$ miles.

The island, as Filchner has stated,[1] is crescentic in outline and is, no doubt, merely a fragment of a volcanic cone. It appears to have resulted from a small eruption which took place in deep water, and it is improbable that it was ever much larger than now. The actual crater presumably lay immediately to the north-east of the existing land, in the bight which Filchner calls Crater Bay.

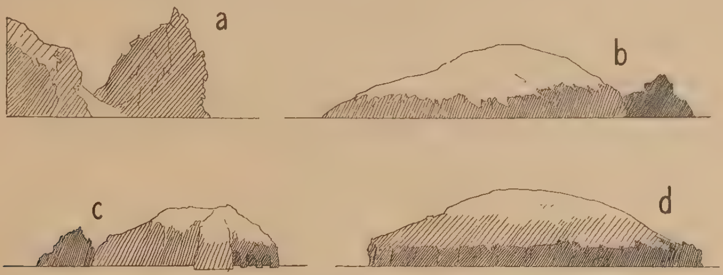

Fig. 6. Leskov Island: sketches by Lt.-Cmdr. J. Irving.

a. Conical rock at the E end, seen from the SSE: distant 5 cables.
b. From the SE: distant 6 cables.
c. From the NE: distant 2 cables; Crater Bay in centre.
d. From the W: distant 5 cables.

During almost all the time that the island was under examination the summit was shrouded in mist, and though the illustrations in Fig. 6 probably give a fairly correct indication of its outline, the height (approximately 600 ft.) could not be determined with any accuracy. By reason of the mist we were not able to decide with certainty whether the island is still active volcanically—a point which Filchner also was obliged to leave in doubt. We think it probable that Larsen was right in describing it as extinct; but since it had no glacier and on the summit only a thin covering of snow, we believe that the ground is still warm.

As will be seen from the chart deep soundings were obtained close inshore all round the island. There is no place where a vessel might anchor, and the land is of such small extent that it could never afford any protection.

Crater Bay, on the north-east side, is flanked by sheer walls of rock falling almost vertically from the summit to the sea. Seen from the west the island is domed in outline (Fig. 6 *d*), with a sloping terrace near the top and with precipitous cliffs at the water-line. At the south-eastern corner there is a conspicuous conical rock, 375 ft. in height, formed of columnar basalt, joined to the main portion of the island a little above sea-level (Plate XV, fig. 1, Figs. 6 *a*, *b*). The cliffs all round the southern and western sides are formed of rugged flows of basaltic lava, in the south inclining towards the water at an angle of 45° but gradually becoming vertical towards the west. In the north-west the cliffs reach a height of 170 ft. and here the rock is columnar in structure and forms three high caverns of no great depth (Fig. 6 *c*). The rock walls of Crater Bay are for the most part reddish and yellowish in colour, apparently consisting of tuff, but much contorted and not showing any definite stratification.

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[1] Filchner, *Zum Sechsten Erdteil*, pp. 114–116, figs. 32–36 (Berlin, 1923).

Owing no doubt to the unsuitable character of its shores Leskov is not inhabited by penguins: the only birds seen round the island were Cape pigeons, Whale birds and Wilson petrels. Larsen, in November, found thousands of Snow petrels (*Pagodroma nivea*) and Cape pigeons nesting on the island. Two small patches of green vegetation were noted and the basalt rocks at many points are rather thickly grown with lichen.

The only place on the island where a landing could be attempted is in the small bay to the west of the conical rock at the south-east corner. Filchner remarks that this might be possible in very fine weather, but we consider it doubtful. Larsen attempted to land, but failed, and there is no record of anyone having succeeded.

Visokoi Island

Lat. 56° 42¼′ S, long. 27° 11½′ W

(Plates XIV and XV, figs. 2, 3; Figs. 7, 8)

This island is 4½ miles long in an east and west direction, 3¼ miles wide, and nearly 12 miles in circumference. It is egg-shaped, with Penguin Point projecting at the east, and with promontories in the north at Finger Point, in the south at Low Point and in the south-west at Wordie Point.[1] Off the coast there are a number of rocks, but all lie close to the shore. The largest is Coffin Rock to the east of Finger Point, and the most conspicuous is a pinnacle rock on the north-west side. There are possible anchorages on the eastern side of the island either north or south of Penguin Point; but as at Zavodovski the swell carries round and no good protection is afforded.

From most points of view the island forms a high rounded mass with very steep coastline (Fig. 7). The summit has been named Mt Hodson[2]; except for brief intervals it was obscured by cloud or steam[3] while the survey was in progress, and an accurate measurement of its height could not be obtained: it is possible that it exceeds Mt Belinda on Montagu Island, and is thus the highest in the group.

Fanning, in his account of Brown's voyage in 1830, describes Visokoi (under the name of Willey's Island) as "a burning mountain with smoke issuing in different places"; Larsen in 1908 speaks of it as "this extinct island", while Hansen in 1927 and Hamilton in 1927–8 noted that it was active. Owing to the cloud cap we were at first in some doubt as to its volcanic activity; for though a strong fumarole was seen on the northern side, the existence of an active crater near the summit could not be established. Later, however, when the island was again sighted at some miles distance on our passage from Candlemas to Leskov, clouds of steam and vapour were seen rising from it in a manner which we all found convincing. The exact position of the crater could not be decided, but we think it probable that one edge is broken away, as on Zavodovski, and that it lies to the north of the summit.

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[1] J. M. Wordie, member of the Discovery Committee.

[2] Arnold Hodson, C.M.G., Governor of the Falkland Islands.

[3] Omitted in Fig. 7.

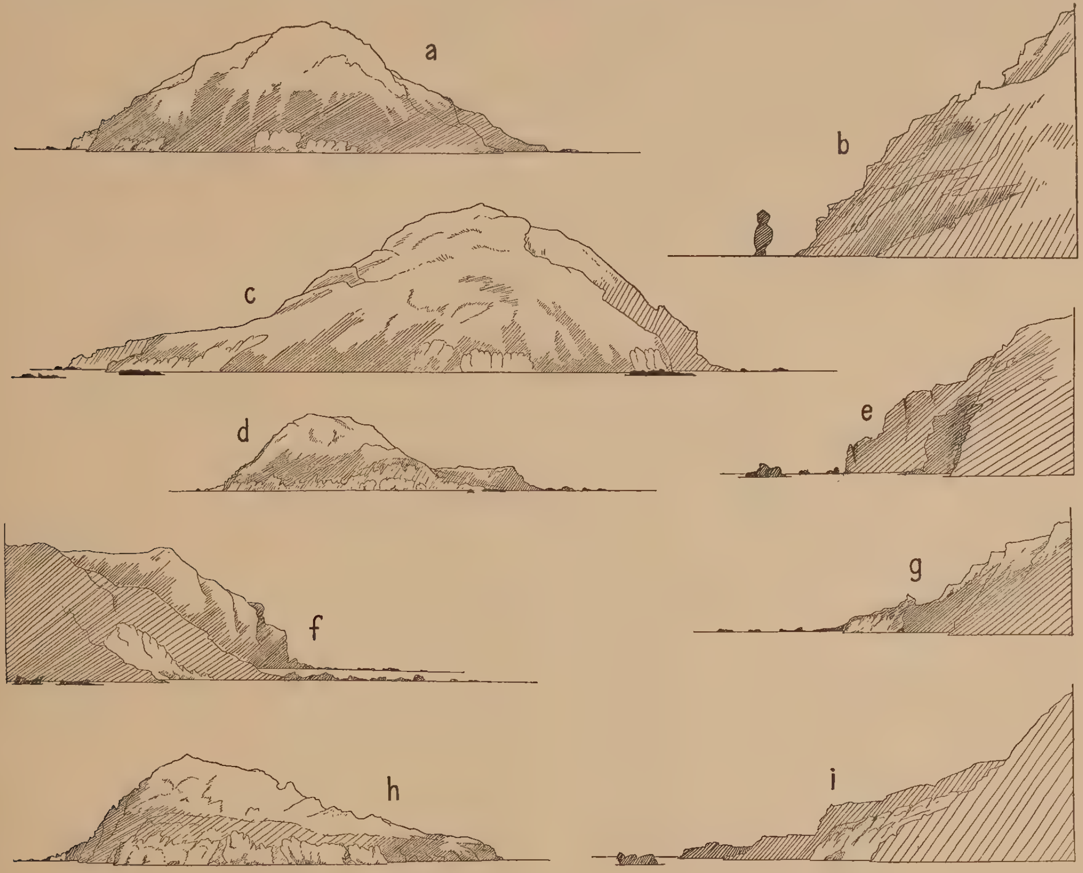

Fig. 7. Visokoi Island: sketches by Lt.-Cmdr. J. Irving.

a. From the SW: Saddle Bluff on the left open of Wordie Point, the latter 1 mile distant.
b. The pinnacle rock on the NW side: seen from the SW and bearing 056°, 1·3 miles distant.
c. From the NE: Finger Point on the right, bearing 277°, distant 2 miles.
d. From the SE: Saddle Bluff on the right, bearing 310°, distant about 2 miles.
e. Wordie Point from the ESE, bearing 290°.
f. Penguin Point in line with Saddle Bluff, seen from the SE: Penguin Point bearing 320°, distant 3 cables.
g. Low Point from the E: bearing 258°, distant 2·4 miles.
h. From the S: Penguin Point on the right, bearing 047°, distant 1·8 miles.
i. Wordie Point and West Bluff from the S: the outlying rock bearing 357°, distant 8 cables.

So far as we were able to observe the whole island is covered in glacier, which descends on all sides from the higher slopes (Plate XV, fig. 2). Rock is visible only on the steep cliff sides and on bluffs or headlands which rise from the water-line and divert the glacier to right or left. On the north-eastern and south-eastern sides of the island eight glaciers extend to the sea, most of them having a narrow beach beneath them formed from their terminal moraine. Between them and on the other sides the cliffs are high and steep with the glacier hanging at their edges. On the upland slopes the ice was pure white, but the lower parts were frequently blackened, presumably by wind-borne dust and debris. On its exposed face the glacier often showed silt bands, and the strata were frequently contorted. At one place on the south-eastern side the glacier face was not vertical but sloped back from a point a little above the water's edge. The sloping surface was here deeply carved into close-set pinnacles and ridges of ice, which we believe to have been formed by unequal melting due to radiation from dust particles (Plate XV, fig. 3).

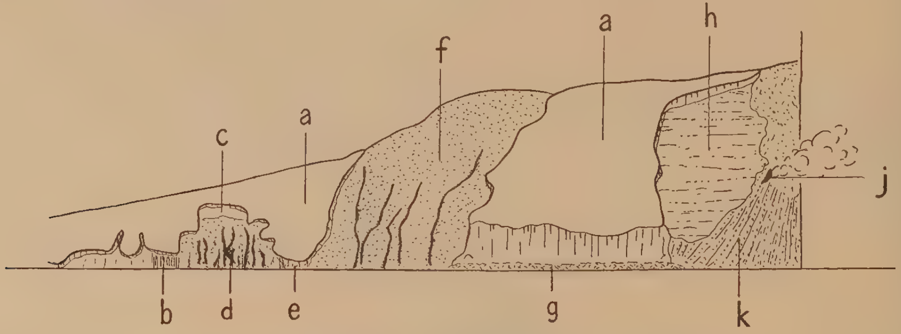

Fig. 8. Rock exposures on the north coast of Visokoi: from a sketch by Mr F. C. Fraser.

a. Glacier.
b. Columnar basalt.
c. Light grey stratified rock.
d. Dark grey rock, merging into red and penetrated by dykes.
e. Ice scree.
f. Reddish and grey rock, covered with lichen and intersected by dykes.
g. Debris of terminal moraine at foot of glacier.
h. Rock stratified in alternate layers of grey and red.
j. Fumarole.
k. Scree of fine ash and loose stones.

The rocks are generally similar to those seen on Zavodovski, but the basaltic plateau of that island has no counterpart on Visokoi. Basalt forms the rocks which lie off the coast, but on the island itself was only seen at a few isolated points. The cliffs are mostly composed of red and grey rock, sometimes stratified and frequently intersected by vertical dykes. On the north side is an extensive scree of fine ash and loose stones and about halfway up is a fumarole emitting steam and vapour (Fig. 8).

The steep cliffs on the northern and north-western sides are the resort of great numbers of Cape pigeons and Silver-grey fulmars, and there is little doubt that this is one of their breeding places. The coast is for the most part unsuitable for penguins and the only place where they have succeeded in establishing themselves is at Penguin Point. Here they have their rookery near the sea and large numbers were seen on the steep slopes above it. They can occupy only a restricted area, for the point is isolated by glacier, which divides at the back of the headland and extends to the water's edge on either side. On the rocky beach below the rookery six Elephant seal had hauled up.

No record of a landing at Visokoi is known to us.

THE CANDLEMAS GROUP

The Candlemas Group was first sighted by Cook on February 2, 1775, when it appeared as two hummocks on the northern horizon. The next day he approached the land more closely and he tells us[1] that it "proved to be two isles....A small rock was seen between them, and perhaps there may be more; for the weather was so hazy that we soon lost sight of the islands and did not see them again until noon, at which time they bore West, distant three or four leagues".

Bellingshausen, however, says in his narrative that the group is composed of three islands[2]—though his atlas shows two only—while Filchner,[3] in his account of the expedition of the 'Deutschland', states positively that there is only one. Filchner says: "Candlemas besteht aus nur einer einzigen Insel, eine Feststellung, die auch von Larsen gemacht worden war. Bellingshausen spricht in seiner Reise-Beschreibung von drei Inseln, die nahe beieinander liegen. Da die Insel aus drei Erhebungen besteht, die auf einen niedrigen Sockel aufgesetzt sind, erscheint dieser Irrtum möglich, um so mehr, als Bellingshausen auf Candlemas nicht gelandet ist. Der Sockel dürfte ca. 33 km Umfang haben".

The reference here made to Larsen appears to be incorrect. In our translation of his report[4] he nowhere states that there is only one island, though he leaves it to be inferred

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[1] Cook, *A voyage to the South Pole and round the World*..., II, pp. 228–9 (London, 1777).

[2] In this Fricker (*The Antarctic Regions*, p. 150 (London, 1904)) has followed him.

[3] Filchner, *Zum Sechsten Erdteil*, p. 117 (Berlin, 1923).

[4] The sections of Larsen's unpublished report which deal with the Candlemas Group read (in translation) as follows:

"November 14th. Gale from NW with foggy weather. 'Undine' has been drifting all night. At 8 a.m. the course was laid for the island named Candlemas. We met with many icebergs in the fog. At 11 a.m. we were as near the island as it was possible to pass, because here are numerous masses of breakers. On the east side of the island there is a bay, but across this there appeared to be sunken rocks of which some were seen in the breakers, and the sea was all in a foam across the bay. Also in the middle of the bay sunken rocks were seen. The southern point of the island is running out into the sea as a low tongue of land, where thousands of penguins dwell. Straight out SE of the point about one mile from land there is a small pointed islet about 35 feet high.

"November 15th. All the night there had been bad weather with snow and fog. During the night the wind had turned over to SW, but continued foggy southward. More soundings and trawlings were made, but the results of the latter were small. Along the east side, outside the sunken rocks, was shallow water with hard bottom. Two trawlings also were made here, but the same small result. A boat was sent ashore to look for fur-seals, but only some hair-seals were seen. From the boat soundings were taken towards all the sunken rocks stretching across the harbour, and it was about 5 fathoms of water where shallowest, and inside all the sunken rocks an excellent harbour for boats was found. On shore here we found a long boom and a from his reference to "the island", and from his sketch-plan (Fig. 10) in which only one is shown.

Provided with this information we concluded that there was one island only; and when, from Visokoi, we sighted two widely separated peaks of the Candlemas Group, we still thought they must be connected by low-lying land, as Filchner had said. On approaching them, steering S 24° E, we found that their outlines agreed closely with Bellingshausen's view taken from the NNE (Fig. 9 *a*), and on closing further it became more and more improbable that any connection existed. Before long a rock was seen between the two (Fig. 9 *b*), then more rocks, until finally we learnt that the earliest description of all was also the most accurate: "two isles...a small rock was seen between them, and perhaps there may be more"—exactly as Cook had stated.

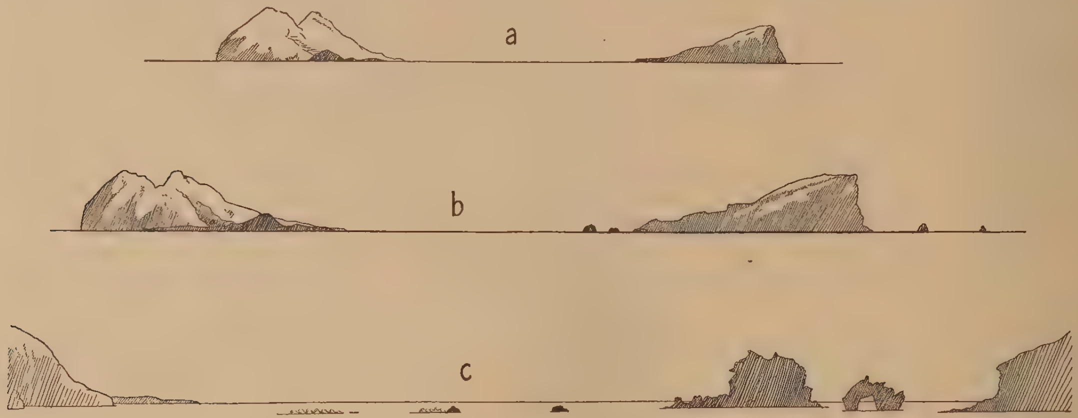

Fig. 9. Views approaching the Candlemas Group on a course of 156°: sketches by Lt.-Cmdr. J. Irving.

- *a*. From a distance of 17 miles.
- *b*. From a distance of 12 miles. Candlemas Island on the left and Vindication Island on the right.
- *c*. Nelson Strait, between the two islands, with Cook Rock and Trousers Rock.

On making our running survey of the islands we found that the larger of the two consists of high snow-covered land at the southern end, while to the north, connected with it by low ground, is a plateau of bare rock from which a volcanic cone rises. It is evident that Bellingshausen thought that these two portions were separate and thus stated there were three islands in the group.

Larsen's sketch-plan (Fig. 10) has no scale, and does not bear any close resemblance to our chart; but it is fairly obvious that it represents the larger island only. He approached the group on a course from Zavodovski, and thus sighted it first at its northern end. He appears to have cruised along the north-eastern side, spent one night under the lee of the land, and next day steamed to Saunders: his diary contains no evidence that

battern, also a jaw-bone and a dorsal vertebra of a small whale. There were two races of penguins there: the black-chinned and that with a black stripe underneath the chin. The boat was brought on board and the course was laid southwards for the next island named Saunders."

he visited the south-western coast. On the course taken he would not have had many chances of sighting the second island and he notes that the weather was foggy on both days.

Filchner visited the group in very bad weather and his account seems to be largely based on Larsen's notes and erroneous sketch-plan. It is clear, however, that he saw both islands. When he states that the circumference is about 33 km. (18 miles), he is no doubt taking both together; for the larger island is about 3 miles long by 1 mile broad, and the smaller about 1 mile long by ¾ mile broad, the circumference of the two being some 14 miles. His sketch, moreover (p. 117), shows both, the snow summits and volcanic crater of the larger island, with the peaks of the smaller seen across the intervening low-lying land.

After our survey was completed we learnt at South Georgia that Capt. Hansen, when he visited the South Sandwich Is. in 1927 (see p. 142), had also reported the presence of two islands in the Candlemas Group.

Cook called the islands Candlemas Islands, after the day on which they were discovered, but we think it will be convenient to retain this name only for the larger of the two, giving a separate name to the other. And since the re-discovery of the smaller island has so strikingly vindicated the truth of Cook's original description, we suggest that it should be called Vindication Island.

As will be seen from the chart there are a number of outlying rocks round the islands, and a dangerous reef, on which stands the rock that Cook reported, extends from Vindication Island half-way across Nelson Strait.[1] The strait is however navigable, probably with at least 10 fathoms,[2] and there is deep water inside Santa Rock, which lies some 2 miles north of Vindication Island. To the west of this island soundings are very uneven, and on the south side of Candlemas there is a bank with a minimum depth of 42 fathoms, separated from the coast by a channel of over 100 fathoms.[3]

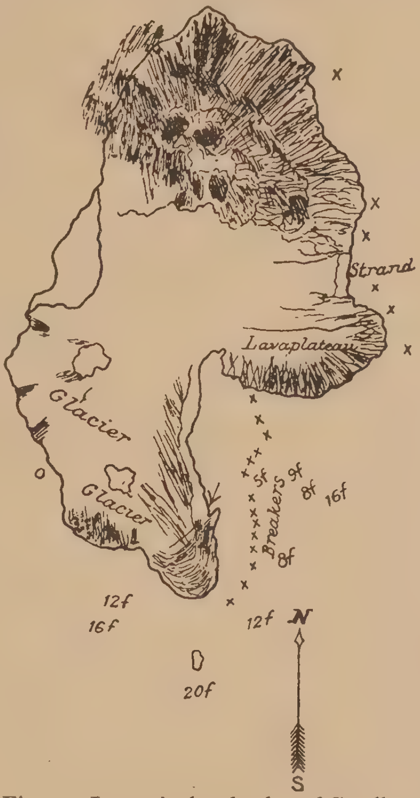

Fig. 10. Larsen's sketch-plan of Candlemas Island.

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[1] The names attached to the more conspicuous features in the topography of the islands have mainly been selected by the Navigating Officer, Lieut. A. L. Nelson. We have, however, thought it right that his own name should find some place on the charts, and we have therefore called the strait between Candlemas and Vindication Island Nelson Strait.—*S. Kemp*, *W. M. Carey*.

[2] At one point a sounding of only 6 fathoms was obtained, but we believe that deeper water is to be found nearer the reef.

[3] The existence of this bank became evident when our first series of soundings, taken on March 3 and 4, was plotted. Thinking that some error might have occurred, an additional series was taken in the same area when we revisited the island on March 17, the result proving the accuracy of the earlier observations.

There are good anchorages at the islands, second only to that in Ferguson Bay in Thule Island. The best is to the east of Vindication Island, between Cook Rock and Rocky Point in 11 fathoms, where there is protection from the north-north-west to south-west with good holding ground. There is also a good anchorage to the south of Candlemas Island for winds from the north, and to the north-east of Vindication Island, north of Cook Rock, for southerly winds.

CANDLEMAS ISLAND

Lat. 57° 02½′ S; long. 26° 40½′ W

(Plates XVI and XVII, figs. 1–3; Plate XVIII, figs. 1, 2; Figs. 10–12)

This island is 3 miles long and 1·4 miles broad, with a circumference of about 7½ miles: it lies with its long axis north-west and south-east. The southern end is buried deep in glacier and bears three peaks, the highest of which is 2580 ft. above sea-level. The northern part is a lava plateau, entirely free from snow, from which rises the cone of a volcano (Plate XVII, fig. 1; Figs. 11 *a*, *c*). The northern and southern parts are connected by a broad stretch of low-lying ground (Fig. 11 *a*). On the eastern side, 6 cables from the coast, is Black Rock, 60 ft. high, while to the south-east and close inshore is Boot Rock, which is 105 ft. high (Fig. 11 *b*).

The plateau in the northern half of the island appears to be composed throughout of rugged flows of black basaltic lava, often showing columnar structure (Plate XVII, fig. 3). Almost everywhere this plateau is very rough, for though on approaching it closely masses of clinker and cinders are seen on the surface, it is not overlaid with fine scoria and ash as on Zavodovski. The north-western coast is bounded by basalt cliffs, 30 to 40 ft. high, much broken by wave action and with deep gullies and chasms. At one point green staining was seen in the rock. In the vicinity of Vulcan Point are several small bays ending in beaches of black sand and to the south there are two larger bays, Tow Bay and Sea-serpent Cove (Fig. 11 *a*). Elsewhere, both east and west of the low ground that intervenes between the northern and southern parts, and in the north on either side of Spit Point, are long, straight, steeply shelving beaches of black sand and boulders. On the western beach were many large masses of ice cast up by the sea.

The main volcanic cone is on the western side of the plateau and rises to a height of 770 ft., the crater itself opening on the southern side of the summit. The cone was of a dark brick-red colour, with splashes of sulphur, and clouds of steam and vapour were issuing from the crater. Immediately to the west of the volcano, and rising to perhaps half its height, are twin cones, also dark red in colour, but not showing any signs of activity. Just to the north of them, at the base of the sheer cliffs which here form the flank of the main cone, is another large crater with its mouth little if at all above sea-level. Wisps of steam and vapour which seemed to be issuing in regular puffs were rising from this crater, and blotches and streaks of sulphur could be seen on the cliff behind it. Members of a boat party, who attempted without success to land near this crater, told us that the tumbled masses of black lava, the dark red rocks and the evident volcanic activities of the place combined to produce a hideous and unearthly scene, reminiscent of Dante's Inferno. As we passed to leeward of the craters strong sulphurous fumes swept across the ship.

There are no penguins in this northern part of the island, but on the low intervening ground they occur in large numbers, and in the south they are to be found wherever the glacier and steep cliffs allow them to establish themselves.

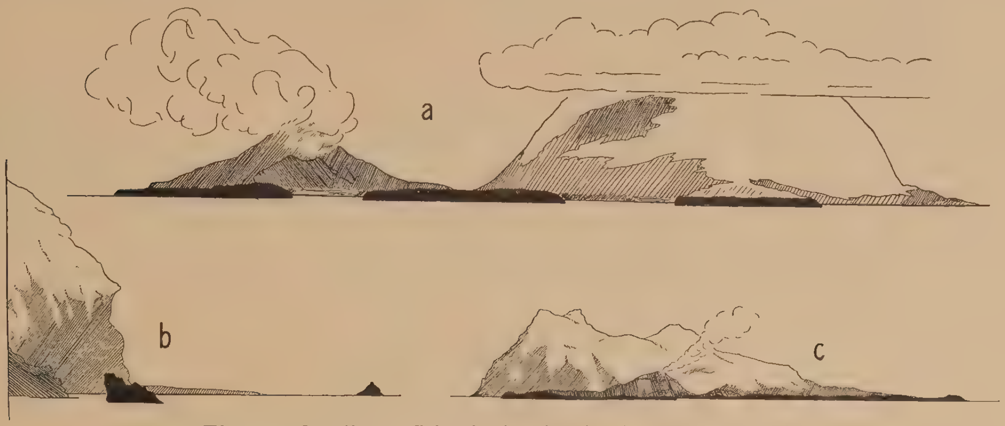

Fig. 11. Candlemas Island: sketches by Lt.-Cmdr. J. Irving.

a. From the westward: the actively volcanic northern part of the island on the left and the glaciated southern part on the right. Tow Bay (left) and Sea-serpent Cove (right) separated by portions of the basaltic plateau.
b. The eastern side of the island seen from the S. Boot Rock in the centre bearing 327°, distant 8 cables. Spit Point and Black Rock on right.
c. From the NW: the volcano bearing 145°, distant 3 miles.

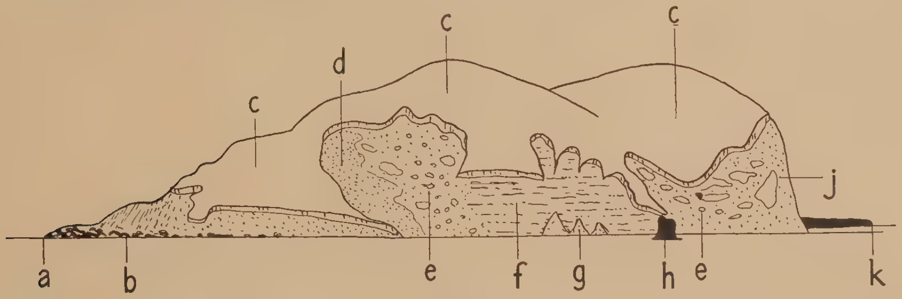

Fig. 12. Rock exposures on the east coast of Candlemas: from a sketch by Mr F. C. Fraser.

a. Shrove Point.
b. Boulders on shore.
c. Glacier.
d. Dark grey-black rock.
e. Black boulders in dark red-brown ground-mass.
f. Stratified grey-black rocks.
g. Ice screes.
h. Boot Rock.
j. Yellow-brown staining on rock.
k. Spit Point.

The whole of the southern part is thickly covered with glacier, which, however, only extends to sea-level at a few points. In one or two places there is an outcropping of rock through the ice covering, and on the northern side there is a huge bluff of dark grey rock round which the glacier divides as it descends to the level land beyond (Fig. 11 *a*). Here, immediately below the edge of the glacier, conspicuous patches of green vegetation were to be seen. On the south side of the island, west of Shrove Point, the glacier in some places hangs at the edge of low cliffs, while in others it falls in huge broken masses to the sea (Plate XVIII, figs. 1, 2). North of the point the cliffs are much higher, especially to the north of Boot Rock, the glacier with its sinuous margin often hanging more than 120 ft. above sea-level (Fig. 12). The thickness of the ice-cap, measured at its broken edge, is about 70 ft.

The exposures on the eastern cliffs were mainly of dark grey rock, which in one place was clearly stratified. At two points boulders included in a dark red ground-mass were seen (Fig. 12), the formation being presumably a tuff agglomerate.

The only recorded landing on this island was made by Larsen in 1908. According to the arrow-mark on his sketch-plan (Fig. 10, p. 167) his boat harbour should be situated near our Boot Rock: we did not find it, and the deep bay with rocks and breakers which he shows on the south-east side has no existence in fact.

Vindication Island

Lat. 57° 04′ S; long. 26° 46′ W

(Plates XVI and XVII, fig. 4; Plate XVIII, fig. 3; Fig. 13)

This island is separated from Candlemas Island by Nelson Strait, rather more than 2 miles wide; in outline it is pentagonal, with a circumference of 3 miles and a maximum breadth in an east and west direction of rather more than 1 mile. At Knob Point in the south-west it rises to a peak 1395 ft. in height, placed close to the sea (Plate XVIII, fig. 3), and there is a lesser peak of 260 ft. at Crosscut Point in the north (Fig. 13 *a*). The surface of the island is somewhat hollowed, draining towards Rocky Point at the south-east angle, and except at this point the coast is formed of steep cliffs, in some parts almost vertical. At the foot of the cliffs, except on the southern side, there is usually a narrow steeply-shelving beach composed of large boulders.

No signs of volcanic activity were to be seen, but it was evident that the ground retained a certain amount of warmth. In its hollowed surface and on the peaks a small glacier was lying, but it appeared to be of no great thickness, and in striking contrast to the glaciated parts of Candlemas Island, the ice melts long before it reaches the coast, forming two streams. The larger of these reaches the sea to the west of Rocky Point, the smaller to the north of it, falling steeply to the beach. This south-east corner is the only place where penguins can gain access to the island and they have large rookeries on either side of the point. They penetrate inland to a considerable distance, and in doing so make use of well-trampled pathways, on which birds could be seen passing and repassing, pausing awhile for chat with a friend and then hurrying on their way, like people in a crowded village street. As on other islands patches of green vegetation were to be seen on the rookeries.

The geological structure of the island is specially well seen in the sheer cliff face on the north-western side between Low Point and Crosscut Point. The rock here is formed of irregular masses of red and brown colour, presumably tuff, with intrusive dykes of

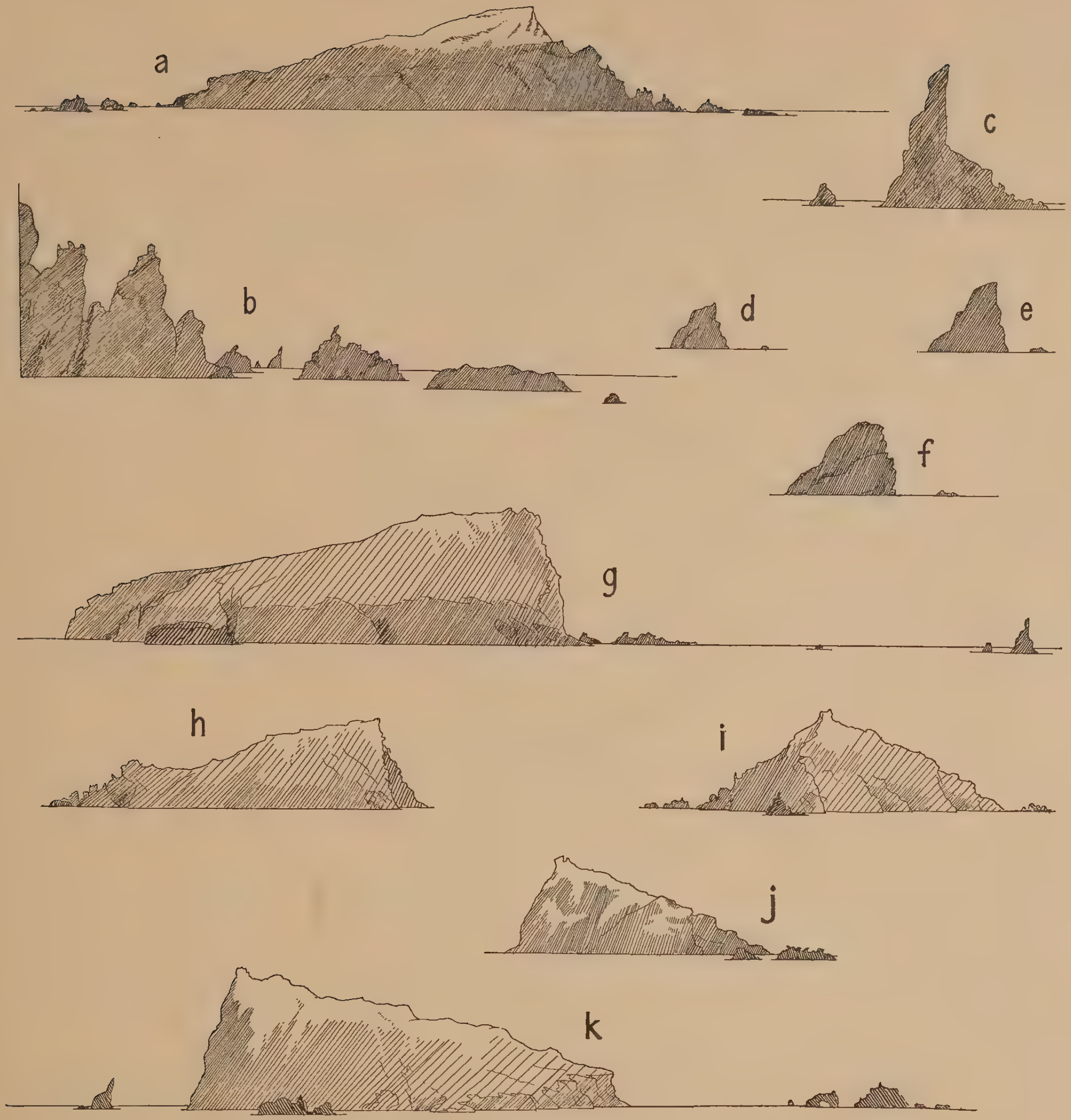

Fig. 13. Vindication Island: sketches by Lt.-Cmdr. J. Irving.

a. From the N: Cook Rock, Trousers Rock and Low Point on left; Crosscut Point and Saw Rock on right. Saw Rock bearing 180°, distant 1 mile.

b. Nearer view of Crosscut Point from same position. Saw Rock on right and Buddha Rock in distance.

c. Buddha Rock from the NNW: bearing 160°, distant 1·6 miles.

d, e, f. Santa Rock. *d*, bearing 290°, distant 1 mile; *e*, bearing 036°, distant 7½ cables; *f*, bearing 070°, distant 5 cables.

g. From the NNW, with Buddha Rock on right and Saw Rock in left fore-ground. Buddha Rock bearing 157°, distant 1½ miles.

h. From the NW: Knob Point on right, Crosscut Point on left, the latter bearing 054°, distant 1·2 miles.

i. From the WSW: Rocky Point and Castor and Pollux Rocks on right; Buddha Rock in foreground, bearing 059°, distant 5½ cables.

j. From the SSW: Rocky Point on right, seen over Castor and Pollux Rocks, bearing 060°, distant 9 cables.

k. From the SSE: Buddha Rock on left; Castor and Pollux Rocks in foreground, bearing 327°, distant 7 cables. On the right Low Point, Trousers Rock and Cook Rock.

grey rock. The dykes run obliquely, vertically and sometimes horizontally, and not infrequently they cross one another. They are evidently of much harder rock than the remainder, for they often stand out as ribs from the cliff surface, and it is they that form all the projecting points on the magnificent saw-edge at Crosscut Point (Plate XVII, fig. 4). At Rocky Point and to the west of it the foreshore is composed of basaltic lava, in one place with some green staining, and the outlying Castor and Pollux Rocks (Fig. 13 *i*, *j*) are also of basalt.

On the reef which runs north-eastward from Low Point are two large rocks: Cook Rock and Trousers Rock (Plate XVII, fig. 2; Figs. 9*c*; 13*k*). Both of these form arches, the tunnel through the latter running north and south, and through the former east and west. Both show horizontal strata of red tuff and dark grey rock. Other conspicuous rocks lie north-north-west from Crosscut Point: Saw Rock 4 cables offshore (Fig. 13 *b*) and Santa Rock (Fig. 13 *d*, *e*, *f*) at a distance of 1½ miles. Buddha Rock (Fig. 13 *c*) is to the west, rather less than 3 cables from the shore.

Since even the existence of this island has hitherto been in doubt, there is naturally no record of any landing. We made three attempts: on the beach at the foot of the cliffs, on the north-western side, and on each side of Rocky Point; but owing to the high swell all failed.

Saunders Island

Lat. 57° 47′ S; long. 26° 26½′ W

(Plates XIX, XX and XXI; Fig. 14)

This island is roughly crescentic in outline, with a large bay, Cordelia Bay,[1] in the east. Its length in a north and south direction is 5 miles, and its breadth, measured east and west, is 5½ miles. The circumference is about 17 miles.

Offshore on the northern side of Cordelia Bay are several rocks. The highest are the Brothers Rocks, 70 ft. above sea-level; they lie at the meeting point of three reefs, with foul ground and breaking water, which completely close the northern entrance to the bay. In the southern part of the bay, close inshore and to the west of the rocks near Nattriss Point,[2] there is a good anchorage in 13 to 14 fathoms, protected from the north-west, through south to south-east. With north-east winds a vessel would find no shelter, and would have to shift to the southern side of the island and lie-to in deep water. To the north of the anchorage our soundings indicate the existence of a closed basin with depths of 50 to 62 fathoms; outside the reefs there is a large area of shoal water with less than 20 fathoms, but elsewhere all round the island the bottom shelves steeply.

In its topography and geology the island is one of the most interesting in the group. The whole of the northern promontory, ending in Harper Point[3], is a low plateau. In the middle of the island is the glaciated cone of Mt Michael,[4] 2640 ft. above sea-level and actively volcanic, while the south-eastern corner is composed of bare hills in which extinct craters are to be seen (Plate XXI, fig. 1).

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[1] Cordelia A. Carey.

[2] E. A. Nattriss, Crown Agents for the Colonies.

[3] F. H. Harper, Secretary, Discovery Committee.

[4] Michael J. de C. Carey.

In all places where the rock is exposed the underlying strata consist of black basalt. This composes the plateau at the northern end, and here it has the typical columnar structure seen at Candlemas and Zavodovski, with cliffs 30 to 40 ft. high, eroded by wave action and carved into small bays and gullies. To the west of Harper Point two large masses, apparently composed of fine volcanic ash or mud, lie on the surface of the plateau. Mt Michael, as will be seen from Plate XX, fig. 1, is most evidently volcanic, a feature first noticed by Capt. Hansen in 1927. During the whole time that the summit was clear it emitted great puffs of steam and vapour at intervals of a few seconds. The cone, none the less, is deeply covered with glacier, extending to the sea on both east and west sides. The surface of the ice is for the most part smooth, with only an occasional ledge of rock projecting through it; but on the northern side a deep rift or gulley, partially free from snow, extends up the mountain, calling to mind the curious fissures seen in the cone of Zavodovski. The lower slopes of the glacier are much blackened by wind-borne dust and debris.

The south-eastern extremity of the island consists of a range of hills with heights of 700 and 800 ft., on which the snow cannot lie owing to the warmth of the ground (Plate XXI, fig. 3). Everywhere, except at Nattriss Point, these hills are composed of a fine-textured grey material, which we believe must be either fine ash or volcanic mud. It is very easily eroded and on both north and south sides is scored by streams of water from the melting snow into parallel runnels and ravines—some of them at least 10 ft. deep. Snow fell while we were at the island: it melted rapidly in most places, but lodged for a longer time in the ravines, giving the hills the appearance of being covered with a finely woven white shawl.

Where the hills join the main body of the island, there is a huge yawning crater, formed of this same ash or mud (Plate XXI, fig. 2), and, since no steam or vapour could be seen issuing from it, we assume that it is extinct. On the southern side of the promontory a large portion of the cliff has fallen away, exposing to view a remarkably perfect half-section of a crater (Plate XX, figs. 2, 3). As the island is approached from the south this bisected crater is a most conspicuous feature, and on close inspection it can be seen that the strata in the cliff face on either side of it run parallel to the edges of the depression and to the top of the cliffs, just as in a text-book section of a typical volcano. The surface of the depression is scored with radial grooves similar to those on other parts of the hills and the diameter of the crater is not far short of half a mile. At Nattriss Point (Plate XXI, fig. 4) and at a number of other places a layer of black basaltic lava can be seen at the water line. The cliff section, however, shows clearly that the hills are composed throughout of ash or mud, and that their appearance is not due to a mud-flow covering other materials. At one or two points on the western side of the island exposures of red tuff were seen above the basalt. In the south of the island, to the west of the bisected crater, a small mound of mud or ash protrudes through the glacier and is evidently still warm. Water from the snow melting on its surface has carried runlets of mud over the surface of the glacier towards the sea (Plate XXI, fig. 5).

The formation of the hills in the south-east corner of Saunders has no counterpart in any of the other islands, for though material of similar appearance is to be seen on Montagu and Bellingshausen, it is of small extent and there is no indication that it was extruded from a separate outlet. Because of the evident way in which the centre of volcanic activity has shifted from one point to another in certain of the islands (e.g. Candlemas and Southern Thule), it may perhaps be supposed that Mt Michael—no doubt the original seat of activity—was for a time quiescent and that it was during this period that the south-eastern hills were formed.

In his atlas Bellingshausen gives a sketch of Saunders Island seen from the north (Fig. 14, *cf.* Pl. XXI, fig. 1), in which the bare hills behind Nattriss Point culminate in a lofty cone, evidently far higher than at the present day. If this sketch accurately represents the conditions in 1820 it is clear that the hills have undergone considerable alteration, due either to renewed volcanic activity, or to erosion.

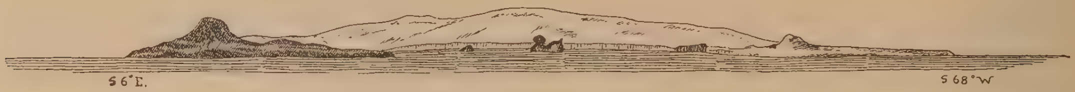

Fig. 14. Saunders I., distant about 4 miles. (After Bellingshausen.)

Cook mentions two hills, seen over the northern point, which might be two islands, and adds, "these only were clear of snow and seemed to be covered with green turf". This statement must refer to the hills at the south-eastern end, but at the time of our visit they showed no traces of vegetation. In Cordelia Bay, on low ground where the glacier ends and the mud hills begin, small patches of green were to be seen, and at this point there is a large rookery of Ringed penguins. A little further east, where a valley gives greater extent to the foreshore, some Elephant seal had hauled up, and here a number of giant petrels were gathered. Round the eastern end of the bay is a steeply shelving beach of black sand where parties of Ringed penguins, with a few King and Gentoo, were walking, and on which some seal (apparently Weddell) were lying. Other colonies of penguins are to be found north of Rocky Point on the west coast, and on Harper and Nattriss Points.

We made an attempt to land in Cordelia Bay, but were prevented by the heavy swell and strong undertow on the beach. The only recorded landing is by Larsen in 1908.

Montagu Island

Lat. 58° 25½′ S; long. 26° 21½′ W

(Plates XXII and XXIII)

Montagu is the largest island in the South Sandwich Group. It is roughly quadrangular in outline, and is rather less than 6½ miles in both length and breadth, with a circumference of about 24 miles. In the south-east there is a promontory ending in Allen Point,[1] and standing on it is a conical hill 1660 ft. in height, which forms a conspicuous feature from many points of view. To the west of the hill is Phyllis Bay,[2] ending in Scarlett Point.[1] Further to the west lies Horsburgh[2] Point. On the northern and western sides of the island, on either side of Borley Point,[3] are a number of rocks and reefs lying within a mile of the shore.

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[1] H. T. Allen, member of the Discovery Committee.

[2] Phyllis V. Horton.

There are good anchorages on either side of Allen Point in depths of 20 fathoms and under. The anchorage to the north of the point gives protection from north-west to south-west, and that in Phyllis Bay from north-west to south-east. Allen Point prevents the swell from following round. To the north-east of the island shoal water extends some distance out to sea but very deep soundings were obtained close inshore in the north-west.

The island reaches its highest point in the lofty summit of Mt Belinda,[4] 4500 ft. above sea-level. It is probably the highest mountain in the group of islands, but may be exceeded by Visokoi, where mist prevented accurate measurement. It was only for brief periods that Mt Belinda was in view; no steam was to be seen rising from it and we think it probable that all volcanic activity has ceased. It is everywhere deeply buried in glacier, which descends from the higher slopes and at the coast sometimes ends in a long and straight ice wall, sometimes falls in broken masses to the water's edge (Plate XXIII, figs. 2, 3) and sometimes hangs at the top of steep rocky cliffs. The eastern side of the island is bounded for 5 miles of its length by a vertical ice face, this being the longest uninterrupted glacier front in the islands.

The conical hill at the south-eastern corner of the island must once have been a subsidiary volcanic outlet, and though for the most part thickly covered with glacier, it shows features which lead us to believe that it still retains a certain amount of warmth. On its north-eastern side dykes protrude through the snow, which here covers the underlying rocks but thinly. To the south there is a mass of bare rock, with a deep smoothly excavated trough or valley in the ice surrounding its base (Plate XXIII, fig. 1). The trough may be caused by radiation from the rock; but elsewhere, when a rock penetrates the ice covering, the latter shows sharp fractured edges in place of the smooth contours here seen. Above Allen Point, on almost level ground that would normally be deep in glacier, there are several large and almost bare patches, with stones and rock showing through a very thin covering of snow. We think these patches at least afford evidence that the south-eastern corner of the island still retains some traces of volcanic heat.

As on other islands the lowest strata seen in rock exposures are usually of black basalt, often columnar in structure, and it is of basalt that the outlying rocks are formed. Above it red and yellowish tuffs with some hard grey rock are to be found. At several points the rocks are clearly stratified, showing three or more horizontal layers of dark grey rock separated by narrow bands of red tuff. Sometimes yellow tuff with red inclusions was to be seen and frequently the rocks were much contorted and intersected by dykes. At the north-eastern corner of the island are low cliffs formed of a light grey rock, perhaps volcanic ash.

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[1] E. W. A. Scarlett, Accountant, staff of Discovery Committee.

[2] H. Horsburgh, Technical Officer to the Discovery Committee, Crown Agents for the Colonies.

[3] J. O. Borley, O.B.E., member of the Discovery Committee.

[4] Belinda Kemp.

Penguins are scarce on the island and were seen only in small numbers on Allen and Scarlett Points. Two Weddell seal were noticed on some rocks on the north-east side, with another near by on an ice floe. No sign of plant life was seen anywhere.

The only recorded landing is by Larsen, who with some difficulty succeeded in putting two men ashore on some rocks "at the southern point of the island"—presumably on Allen Point.

Bristol Island

Lat. 59° 01$\frac{1}{2}$′ S; long. 26° 31′ W

(Plates XXIV, XXV and XXVI; Fig. 15)

This island is roughly oval in shape, with a projection on the north side ending in Fryer Point[1] and with Harker Point[2] in the south. From east to west it is about 5 miles in length, and from north to south 4$\frac{3}{4}$ miles; its circumference is 14 miles. The highest point of the island is Mt Darnley,[3] 3600 ft. in height, situated to the south of the middle. To the north-east is a second summit of about 1600 ft., and in the east is a conical hill, 1200 ft. high, which forms a conspicuous land-mark (Plate XXV, figs. 1, 3; Fig. 15 *a*). On the south side of the island is a great bluff of rock, rising very steeply from the waterline to a height of 1900 ft.

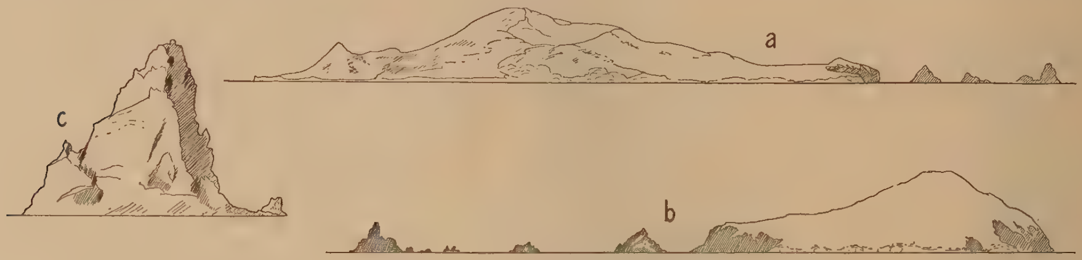

Fig. 15. Bristol Island: sketches by Lt.-Cmdr. J. Irving.

a. From the N by E: distant about 6 miles.

b. From the SW: Grindle Rock, the inner of the three outlying rocks about 1 mile distant.

c. Freezeland Peak from the NE: bearing 220° and distant 3·2 miles.

To the west of the island stand three rocky islets of imposing appearance. The outermost, situated 3 miles from the mainland, is a magnificent structure, with a towering pillar of rock 900 ft. in height and a lesser summit of about 620 ft. (Plate XXVI, figs. 1, 2; Fig. 15 *c*). This rock was the landfall that Cook made when he discovered the South Sandwich Group, and he named it Freezeland Peak after the man who first sighted it. The middle and inner rocks, which we have named Wilson Rock[4] and Grindle Rock,[5] are respectively 500 and 700 ft. in height (Plate XXVI, figs. 3, 4).

[1] D. H. Fryer, Lt.-Cmdr., R.N., Captain of H.M. Surveying Ship 'Fitzroy'.

[2] A. Harker, of Messrs Flannery, Baggallay and Johnson, Consulting Naval Architects.

[3] E. R. Darnley, Chairman of the Discovery Committee.

[4] Sir Samuel H. Wilson, G.C.M.G., K.C.B., K.B.E., Permanent Under-Secretary of State for the Colonies.

[5] Sir Gilbert E. A. Grindle, K.C.M.G., Permanent Under-Secretary of State for the Colonies.

At Bristol it is possible to anchor, with good holding ground and protection from wind, anywhere on the northern and eastern sides; but the shape of the island permits the swell to follow round, no matter what its direction may be. South of Grindle and Wilson Rocks there is very deep water, and between them is a basin, apparently enclosed, with depths of over 50 fathoms. This passage is navigable, as is that between Wilson and Freezeland where soundings of not less than 25 fathoms were obtained. Between Grindle Rock and the mainland is a continuous reef with breaking water.

Bristol Island is deeply covered with glacier, which extends to the coast in every direction (Plate XXV, figs. 1–3): on the eastern side and to the west of Fryer Point are uninterrupted glacier faces each more than three miles in length. At a number of points the structure of the rock is exposed in steep cliffs, with the glacier hanging above. Measurements were made of the height of the glacier face on the eastern side of the island, and the heights obtained at four points as we moved southwards along the coast were 175, 210, 140 and 260 ft. We think that the average thickness of the ice-covering on all the glaciated islands (Montagu, Bristol, Cook and Thule) may be reckoned at 200 ft.

No steam was seen rising from any part of the island: we are satisfied that all volcanic activity has ceased, and nowhere did we see any indication that the ground still retains warmth. Looking back on the island from the north, on our passage to Montagu, we noticed that the highest parts of the island had the shape of a horse-shoe, suggesting that they once formed part of the rim of a large crater. The appearance is shown, though not very clearly, in Plate XXV, fig. 3. We were not able, however, to come to any definite conclusion on this point: the crater, if it ever was one, must have been very large, with a diameter of about two miles.

The rocks on Bristol are similar to those on the other islands. At Fryer Point black basaltic lava is to be seen and the rock exposures on the bluff on the south side, at the western headland and in other parts, are of yellowish and red tuff, or tuff conglomerate, sometimes stratified with a grey rock interposed between the layers, but frequently much contorted and with many intrusive dykes.

From a geological point of view the three large outlying rocks appear to be more interesting than any other place in the entire group of islands (Plate XXV, fig. 4; Plate XXVI, figs. 1–4). The great pillar on Freezeland is composed of a pale brown rock of a kind not seen elsewhere. It showed distinct signs of bedding and in the upper part of the column some broad reddish bands. We believe this may be a sedimentary rock. The eastern part of Freezeland, forming the lesser of the two summits, is different; it is formed of a brownish rock, with vertical fissures and striation, and may be metamorphic. Wilson Rock, nearer the mainland, is a vast mass of black columnar basalt, while Grindle Rock repeats the reddish and yellowish tuffs seen on the adjacent headland of the island. Thus, if our conjectures are correct, the whole succession of rock formations in the Sandwich Group is to be found in these three islets. Freezeland shows the only likely exposure of the underlying sedimentary series that we know to exist, Wilson is of the overlying basalt, here seen in far greater thickness than elsewhere, while Grindle is formed of the superposed tuffs which are characteristic of all the islands of the group.

On the main island penguins were seen at one point only—a small rocky headland on the south-western side. They have, however, established themselves in numbers on Freezeland, where the slopes of talus from the higher rocks appear to afford an attractive site. No penguins were to be found on Wilson Rock, but they occur on Grindle, where also there are some small but conspicuous patches of bright green vegetation. On all three islets great numbers of Silver-grey petrels were seen. Leopard seal were noticed in the water off the penguin rookeries on Freezeland.

Larsen reports that he landed some men on Bristol to look for Fur seal, but found none. He does not state where the landing was made. It might be possible to land on Freezeland in exceptionally good weather, but it would be difficult, as the shore is fringed with boulders among which a heavy surf breaks.

Southern Thule Group

Cook gave to this group of islands the name of Southern Thule; he saw the land only from a distance and thought it might be a projecting headland of an Antarctic continent. Bellingshausen, forty-five years later, sailed round the group, and describes it in the following manner: "Thule consists of one high rock and three small islands, of which one is notably smaller than the others. These islands are high and unapproachable, and lie in Lat. 59° 26′ S, Long. 27° 13′ 30″ W. The middle one, the largest, is about six miles long; I called it Cook Island, in honour of the great explorer....The most westerly island is three miles long and the smallest is two-thirds of a mile in length. Between the two largest islands we found a rock; all three were covered with snow and ice." On his chart, however, Bellingshausen shows only two islands: the western is named Thule Island and the eastern "Kun Island", and the rock lies off the south-east corner of the former.

Since then, for more than a century, practically no additions to our knowledge of the group have been made, though interest was aroused by Morrell's statement in 1832 that there is a good harbour on the north-east side of the westernmost island. In 1928, however, Mr J. E. Hamilton in a catcher belonging to the whaling factory 'Anglo-Norse' reported that he had seen the third island described by Bellingshausen and had steamed through the strait lying between it and the island adjacent to it. In *The Antarctic Pilot* (1930) Bellingshausen's name has been appropriately used for this third island, and two sketches of it by Mr Hamilton are reproduced.

Our chart of the other two islands differs considerably from that shown in Bellingshausen's atlas; there is, however, a similarity in general outline, and the rock is approximately in the position in which he placed it. Contrary to Morrell's statement there is no harbour in the islands, but a good anchorage exists at the south-east corner of Thule Island.

Bellingshausen Island is a volcano which still shows signs of activity. Thule and Cook

Islands are covered deep in glacier and the way in which they have been formed would probably have been misinterpreted, or have remained obscure, were it not for an interesting discovery which we owe to our echo-sounding apparatus. With this apparatus we found that a very deep basin exists between Cook and Thule Islands in Douglas Strait.[1] In the middle it has soundings of over 400 fathoms, while at the north and south entrances there is less than 20 fathoms. That the basin was once a volcanic crater scarcely admits of doubt. It is probable that by its eruption it originally formed one large island, and that of this island Cook and Thule are the only portions now remaining.

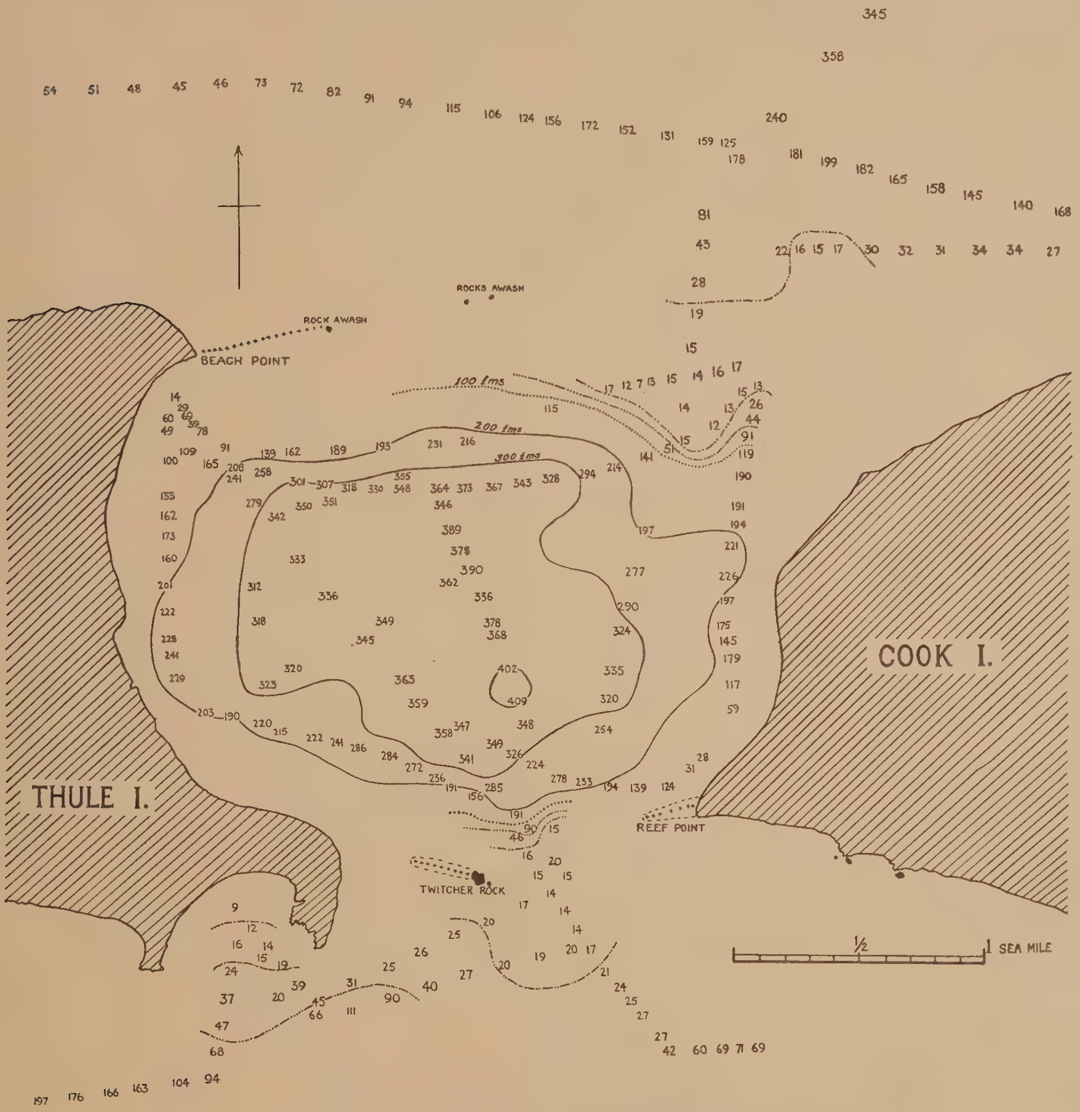
ROCKS AWASH
ROCK AWASH
BEACH POINT
100 fms
200 fms
300 fms
THULE I.
COOK I.
TWITCHER ROCK
REEF POINT
½
1 SEA MILE

Fig. 16. Chart of Douglas Strait, Southern Thule, showing soundings in the submarine crater.

---

[1] Rear-Admiral H. P. Douglas, C.B., C.M.G., member of the Discovery Committee.

The soundings taken in Douglas Strait, with the approximate positions of the 200, 300 and 400 fathom contours, are shown in Fig. 16. It will be seen that deep water extends close up to the eastern and western shores where the coast on both sides is formed of high precipitous cliffs and steeply sloping glacier. The northern entrance to the strait is closed for a great part of its breadth by a reef with sunken rocks extending eastwards from Beach Point. The southern entrance is narrower and lies between the end of the rocks off Reef Point and Twitcher Rock, from which shoal water extends towards Thule Island.

Observations were made on the plankton and hydrology of this submerged crater at a station situated near the middle of the strait. A sounding with the Lucas machine gave a depth of 358 fathoms (= 655 metres). The bottom sample was of black mud, and its strong smell of sulphuretted hydrogen indicated that the lower layers of water were stagnant.

Table II.

Station ... ... Date ... ... Position		368 8. iii. 30 Douglas Strait		369 9. iii. 30 Between Bellingshausen and Bristol Islands	
Depth					
Fathoms	Metres	T. °C.	S ‰	T. °C.	S ‰
0	0	0·11	34·02	0·28	34·01
5·5	10	0·10	34·04	0·22	34·01
11	20	0·10	34·05	0·20	34·01
16	30	0·09	34·05	0·18	34·00
22	40	0·07	34·05	0·08	34·04
27	50	0·05	34·05	– 0·30	34·07
33	60	0·05	34·05	– 0·39	34·16
44	80	0·02	34·07	– 0·60	34·24
55	100	0·01	34·10	– 0·91	34·41
82	150	– 0·10	34·11	– 0·50	34·50
109	200	– 0·78	34·16	– 0·31	34·58
164	300	– 1·60	34·36	– 0·05	34·60
219	400	– 1·60	34·36	0·15	34·67
328	600	– 1·63	34·36	0·22	34·67
437	800	—	—	0·19	34·69
547	1000	—	—	0·14	34·69
820	1500	—	—	– 0·05	34·68

The temperatures and salinities are given in Table II, and with them, for comparison, a similar series taken in the open sea between Bellingshausen and Bristol Islands. The latter series shows the conditions which normally prevail in the area, and it will be seen that four distinct layers of water are to be distinguished by temperature. Below the upper layers, warmed by contact with the air, is a cold stratum with a minimum at 55 fathoms; beneath this is a warm layer with a maximum at 328 fathoms, while at the bottom cold water is again found. In Douglas Strait the temperatures are quite different; they decrease from top to bottom, and though they fall quickly between 82 and 164 fathoms, no trace of the usual layering for these latitudes is to be seen. This is due to the fact that the basin is closed. The water that reaches it must flow over either the northern or southern edges, and since the depths here do not exceed 20 fathoms, only that from the homogeneous uppermost layer can find access. Since there is a southerly set of about 1 knot in Douglas Strait the inflowing water will come from the north.

It will be noticed that the bottom temperatures in the basin are extremely low, much below any of those in the comparative series. We believe this to be the effect of winter conditions. In winter, and indeed for the greater part of the year, the islands are surrounded by pack-ice, which will also invade the strait. Air temperatures will be very low and the pack will remain as a solid frozen mass for long periods. Convection currents will be set up beneath the ice-covering and the whole of the water will become chilled. When the ice disappears circulation will be restored; but it will be limited to the upper layers, the bottom water imprisoned beneath it permanently retaining its winter temperature. The temperatures afford proof—if proof were needed—that no trace of warmth persists in the crater.

The figures for salinity indicate by their uniformity in the upper layers that active circulation is in progress down to a depth of 40 fathoms, and in conformity with the temperature readings they also show an abrupt change between 82 and 164 fathoms (Fig. 17).

The results suggest that the circulation in the strait, when not closed by ice, is on the lines indicated in Fig. 18. The current running at the surface from north to south will set up a flow in the same direction in the water immediately beneath it, with the return current lying at a depth of 40 fathoms. The latter, by the friction it exerts, will induce a much slower streaming movement in the water below; this will rotate in the reverse direction to that above, and its lower level will be at about 130 fathoms, where both temperature and salinity show that a discontinuity layer exists. The bottom of the basin from 130 to 400 fathoms must be filled with water which is almost or quite motionless.

The plankton collections show that in Douglas Strait life exists in considerable quantity down to at least 273 fathoms; for a net hauled from this depth to 137 fathoms (500–250 metres), and then closed, contained numerous copepods and other organisms. In all the nets used below 55 fathoms specimens of a very large red and white amphipod, *Eusirus antarcticus*, were obtained, and a larger net hauled obliquely from 80 fathoms to the surface caught great quantities of *Euphausia superba*, the crustacean which in the Antarctic forms the food of Blue and Fin whales. At the bottom itself life is deficient: a dredge brought up a quantity of evil-smelling mud, containing practically nothing beyond three star-fish and a number of Polychaete worms living in black tubes.

Few instances of volcanic craters inundated by the sea have been recorded: we know of two only—Deception Island in the South Shetland Group and St Paul Island in the southern Indian Ocean. Both of these have only one opening and both are much shallower than Douglas Strait. At Deception the depth of the water in the crater is 93 fathoms and at St Paul 38 fathoms. Cook and Thule Islands, whose steep cliffs border

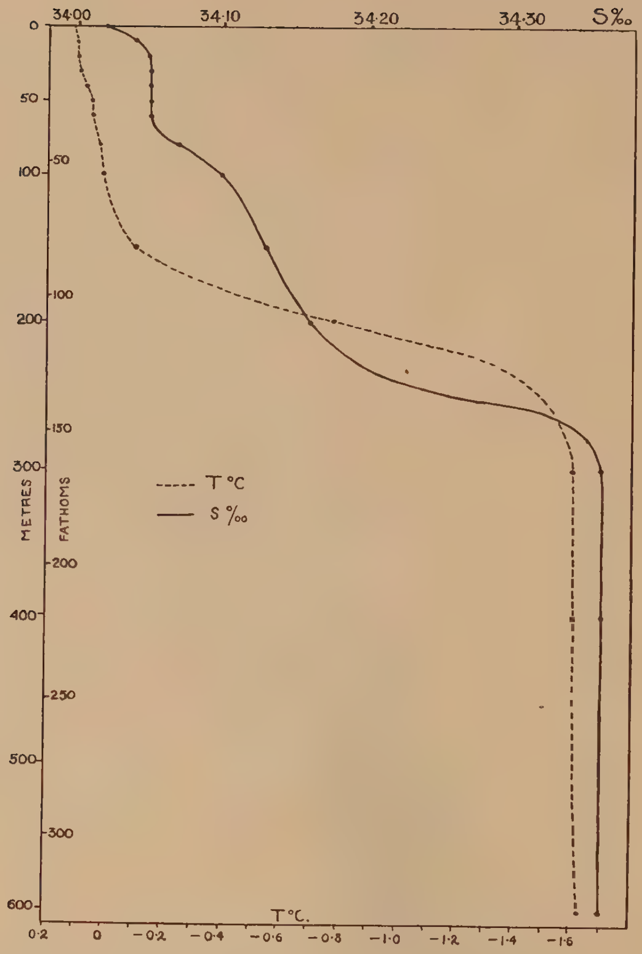

Fig. 17. Vertical distribution of temperature and salinity in Douglas Strait.

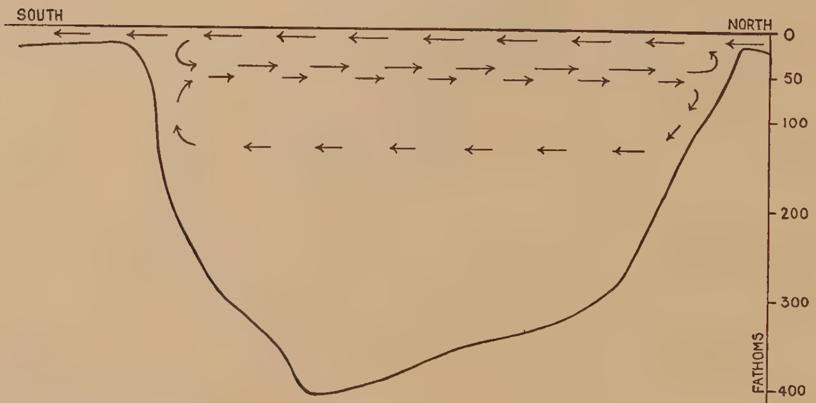
SOUTH
NORTH
0
50
100
200
300
400
FATHOMS

Fig. 18. Diagrammatic section of Douglas Strait, showing probable circulation of the water. Vertical scale exaggerated nearly three times.

Douglas Strait, are permanently ice-bound, and there is consequently little if any drainage into the basin. St Paul and Deception Islands, on the other hand, still show signs of volcanic activity; there is no snow on the former, and on the latter there are large tracts of bare ground. The considerable depths in Douglas Strait are perhaps due in part to this lack of drainage, while with two openings and a comparatively rapid surface current suspended matter in the sea water will not readily be deposited.

Soundings taken elsewhere round the islands do not show features of any special interest. There is very deep water on both the northern and south-western sides of Thule Island, while Maurice Channel, between Bellingshausen and Cook Islands is shallow throughout, with 14 to 17 fathoms in the middle.

Ferguson Bay in Thule Island (Plate XXXI, fig. 1) is the best anchorage in the South Sandwich Group, with good holding ground and protection from the south-west, through west, to east. Other anchorages are to the north-east and south-east of Cook Island, though at these the swell may be heavy. Douglas Strait is too steep to be of much use.

BELLINGSHAUSEN ISLAND

Lat. 59° 25¼′ S; long. 27° 03½′ W

(Plates XXVII and XXVIII; Fig. 19)

Bellingshausen Island is the smallest of the Southern Thule Group and lies to the north-east of Cook Island, from which it is separated by Maurice Channel,[1] 1½ miles wide. In striking contrast to its neighbours it still shows evident signs of volcanic activity. In outline it is irregularly oval, hollowed on the eastern side and with Hardy Point[2] projecting to the west: it has a length of 1·1 miles, a breadth of 8 cables and a circumference of rather more than 3 miles.

The single volcanic cone ends abruptly in the ragged edges of a yawning crater, and the highest point, on the northern margin of the latter, is 530 ft. above sea-level (Plate XXVIII, figs. 1–3; Fig. 19). The inner walls of the crater are sheer, or slope very steeply, and steam and vapour were seen rising from a point below the brim. On the southern and south-western sides the base of the cone slopes gently upwards from a plateau; in the west, north of Hardy Point, there are cliffs of no great height, while in the east a sheer wall of rock rises to the crater's edge. North of Isaacson Point[3] so much of the rock has split away that it looks as if one more fall would breach the crater to sea-level (Plate XXVIII, fig. 4).

The steep eastern and northern sides are practically devoid of snow, but on the south and west sides there are large patches and streaks, interspersed with considerable areas of bare ground (Plate XXVIII, fig. 3). At one point on the south-eastern side, not far below the brim of the crater, steam was issuing from a fumarole.

[1] H. G. Maurice, C.B., member of the Discovery Committee.

[2] A. C. Hardy, Professor of Zoology, University College, Hull.

[3] Miss S. M. Isaacson, attached to Scientific Staff, Discovery Committee.

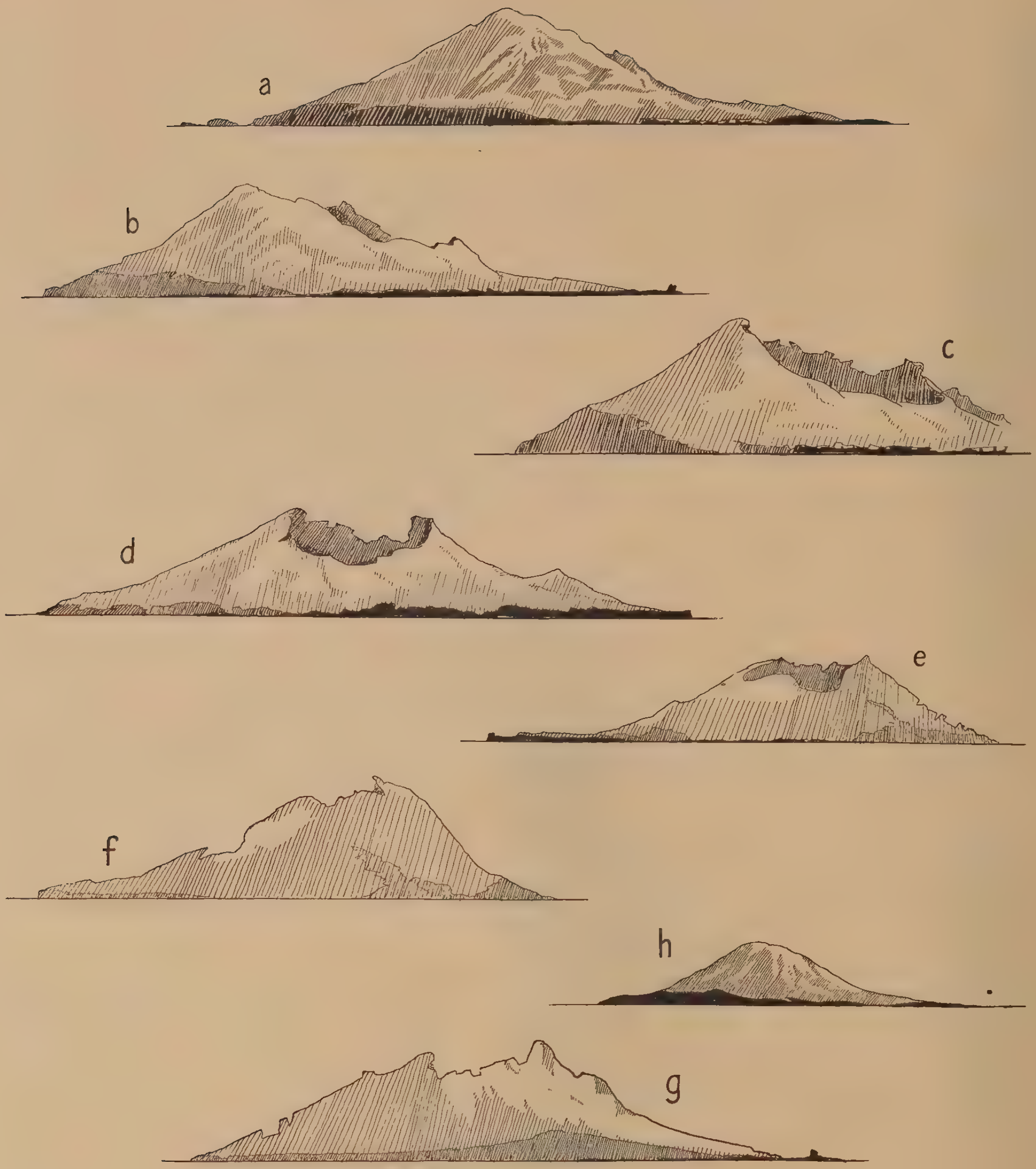

Fig. 19. Bellingshausen Island: sketches by Lt.-Cmdr. J. Irving.

The steam and vapour from the volcano are not shown.

a. From the WSW: Hardy Point to right of centre bearing 064°, distant 1·1 miles.
b. From the SW: Isaacson Point on the right bearing 065°, distant 1·4 miles.
c. From the SSW: Hardy Point on the left bearing 015°, distant 1·6 cables.
d. From the SSE: Hardy Point on the left bearing 318°, distant 9 cables.
e. From the NE: Isaacson Point on the left bearing 240°, distant 6 cables.
f. From the NNE: Isaacson Point on the left bearing 245°, distant 6 cables.
g. From the ENE: North Point on the right bearing 270°.
h. From the W by N: Summit bearing 100°, distant 8·5 miles.

The coast-line of the plateau on the southern and western sides is everywhere steep and rocky, and is formed as on other islands of black columnar basalt. The surface of the plateau appears smooth and is probably overlaid with scoria and ash. The cliffs between Isaacson Point and Jagged Point are black, brown and red, and seem to be composed mainly of tuff and ash: there are some fallen boulders on the narrow beach at their base. Above Jagged Point a projecting spur forms an irregular knife-edge of curious outline (Plate XXVIII, fig. 4) and the rock here is fine-grained and pale yellowish brown, apparently a hard volcanic mud, with an underlying stratum of black basalt, visible at the water-line. The lower cliffs on the north-east side are stratified with alternate layers consisting apparently of tuff agglomerate and ash.

Ringed penguins are very abundant on the island and have formed rookeries near the shore at a number of points. On the north-east side, as already mentioned, small parties of them were seen to have ascended the steep slopes of the cone almost to the brink of the crater and to a height of at least 450 ft. above the sea. For a penguin such a journey must be very arduous, and their object—unless it be to admire the view—is difficult to understand.

One or two patches of green vegetation were seen on the plateau and at several places the snow was remarkably stained with reddish pink, yellow and yellowish green. The first of these is the familiar "red snow", caused by the unicellular alga *Chlamydomonas*, and samples of it were collected on Thule Island. The yellow and yellowish green patches were probably also due to algae, but of this it was not possible to be certain.

There is no record of any landing on the island.

Cook Island

Lat. 59° 26¾′ S; long. 27° 09½′ W

(Plates XXVII and XXIX; Plate XXX, fig. 1; Fig. 20)

This island is the largest and highest in the Southern Thule Group. It is rather regularly oval in outline, but in the west there is a shallow bay which faces Douglas Strait and is bounded at the south by Reef Point. Elsewhere only small projections interrupt its even contour: Resolution Point[1] in the north-east, Swell Point in the east and Jeffries Point[2] in the south. The island is nearly 3½ miles long and 2½ miles wide, its longer axis lying east and west; in circumference it is 9½ miles. It has three ice-capped peaks, of which Mt Harmer,[3] situated a little to the north of its middle point, is the highest, having an altitude of 3660 ft. above sea-level.

Cook Island is buried deep beneath an ice-cap (Plate XXIX; Fig. 20), and it is only below the hanging glaciers and on headlands that the underlying rocks are visible. The glacier follows the undulations of the rock beneath, and frequent ridges and protrusions where the ice is crevassed indicate inequalities in the surface below, which have not yet been worn away by ice action. No measurements were taken of the glacier face, but there is no doubt that it is fully as thick as on Bristol Island.

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[1] H.M.S. 'Resolution', in which Cook circumnavigated the globe.

[2] Miss M. E. Jeffries, staff of the Discovery Committee.

[3] Sir Sidney F. Harmer, K.B.E., Sc.D., F.R.S., vice-chairman of the Discovery Committee.

As already explained (p. 179) the crater from which both Cook and Thule originated is probably that now submerged beneath the sea in Douglas Strait. The two are thus fragments of a single much larger island, which in size must have approached Montagu —now the largest of the group.

All round the coast is precipitous, alternating between steep rugged cliffs with glacier hanging above them and glaciers reaching to the water's edge. If small ice-falls down the hill-sides are omitted, there are in all eight glaciers which reach the sea, the largest being half a mile in breadth. The most extensive rock exposures are to be found bordering Douglas Strait, and in the south-east between Swell Point and Jeffries Point. The rocks here, and indeed at all points where they are visible, are yellow, red or brown in colour, sometimes showing signs of stratification, but always very much crumpled and contorted, often seamed with dykes of grey rock and sometimes apparently with large intrusive masses of brown material showing vertical striation.

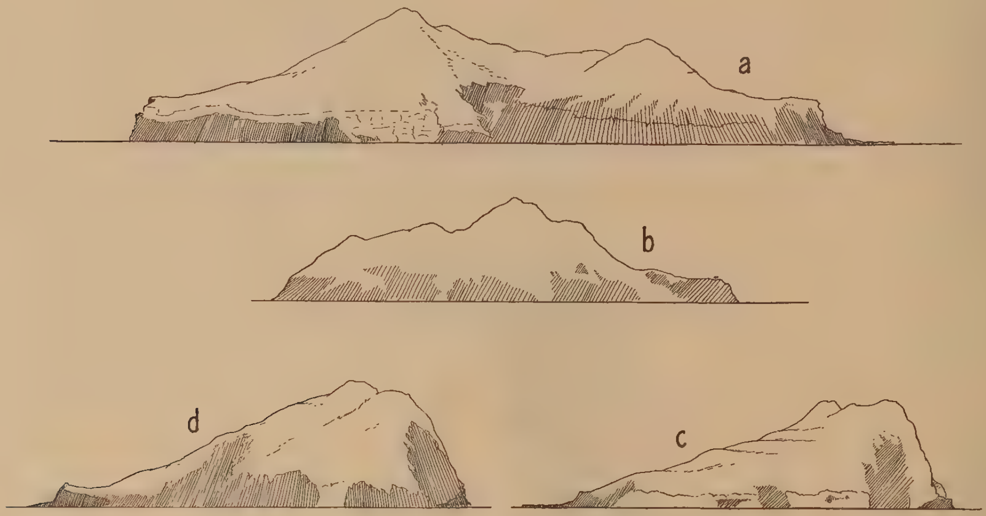

Fig. 20. Cook Island: sketches by Lt.-Cmdr. J. Irving.

a. From the W: Reef Point on the right bearing 110°, distant about 2 miles.
b. From the NE: Swell Point on the left bearing 203°, distant 3·6 miles.
c. From the SW: Reef Point on the left bearing 009°, distant 1 mile.
d. From the S: Jeffries Point to right of centre bearing 000°, distant 3 cables.

Cook Island differs from all the others of the group except Leskov in that, so far as we were able to observe, penguins are entirely absent. They are certainly extremely scarce, and this is evidently due to the very steep coast which is at no point suitable for a rookery. On the high cliffs facing Douglas Strait, myriads of Silver-grey petrels were perched and we think it more than probable that they nest here.

There is no record of any landing on the island.

Thule Island

Lat. 59° 26¾′ S; long. 27° 19½′ W

(Plates XXVII and XXX, figs. 2–4; Plate XXXI; Fig. 21)

This island, the westernmost of the Southern Thule Group, is roughly crescentic in outline, with a large bay in the east, bordering Douglas Strait, and with Cape Flannery[1] projecting to the west. Its extreme length, measured in an easterly and westerly direction, is 3¼ miles; its breadth is 2½ miles and its circumference about 10 miles. The bay ends in the north at Beach Point (Plate XXX, fig. 3), from which a reef with several rocks awash at the surface extends seawards for over a mile, greatly restricting the entrance to the strait. At the southern end of the bay, situated about half a mile from the island and with breakers and foul ground between, is Twitcher Rock[2] (Plate XXXI, figs. 3, 4; Fig. 21 *e*, *f*). This rock, first seen by Bellingshausen, is a conspicuous feature, rising to a height of 180 ft. At the south-east corner the land, which is here a low plateau, trends to the south; it ends in Hewison Point[3] (Plate XXXI, fig. 1; Fig. 21 *g*) and between this and Herd Point[4] further to the west is Ferguson Bay,[5] which affords the best anchorage in the South Sandwich Group. The island rises to its highest point in Mt Larsen,[6] which overlooks Douglas Strait and is 2230 ft. above sea-level.

Like Cook Island, Thule is buried beneath an ice-cap (Plate XXX, fig. 2). In the middle of the south-western side a jagged ridge of black rock protrudes through the glacier; in the south-east the lava plateau ending in Hewison Point is largely devoid of snow (Plate XXXI, fig. 1), and in the north-east the isolated ridge of rock at Beach Point is also bare (Plate XXXI, fig. 3). With these exceptions the ice-cap is practically continuous over the island, the glacier sometimes extending to the water's edge, but more often breaking off abruptly at the edge of the steep cliffs which form the greater part of the coast-line. Conspicuous silt bands are to be seen in the face of the glacier at the head of Ferguson Bay (Plate XXXI, fig. 2), and on its surface some patches of "red snow" were observed.

The plateau at Hewison Point (Plate XXXI, fig. 1) is formed of black columnar basalt; on its western side it is cut into a number of small creeks in which a landing could doubtless be made in fine weather. Herd Point is a protruding spur of basalt, as are also most of the rock exposures visible on the south-western side of the island. Near Cape Flannery there are beds apparently composed of yellowish tuff and ash, while at the cape itself there is reddish tuff below and grey rock above. Farther north, at a point with outlying breakers, the rocks are definitely stratified, three layers of ash separated by red tuff lying on a base of black basalt. The isolated ridge at Beach Point is about 150 ft. in height, and is composed of hard grey rock, with outcrops of red tuff, and with a soft crumbling black rock, perhaps volcanic ash, at the summit. The steepest cliffs are on the eastern side facing Douglas Strait, and the rocks here closely resemble those opposite on Cook Island. They consist of contorted masses of red, yellow and dark brown, with intrusive grey dykes, the colours showing vividly when lit by a rare gleam of sunshine.

---

[1] Sir Fortescue Flannery, Bart., member of the Discovery Committee.

[2] John Montagu, 4th Earl of Sandwich, was First Lord of the Admiralty from 1771–82, during the period of Cook's voyages, and the group of islands is named after him. It is said that "for corruption and incapacity Sandwich's administration is unique in the history of the British Navy". He was notorious for his evil living, and having taken a leading part in the prosecution of one of his former associates in vice, was popularly known by the nickname of "Jemmy Twitcher".

[3] Lt.-Col. Hewison, of Messrs Ferguson Bros.

[4] R. D. Herd, of Messrs Ferguson Bros.

[5] Messrs Ferguson Bros., Port Glasgow, builders of the R.R.S. 'Discovery II'.

[6] C. A. Larsen, the pioneer of modern Antarctic whaling.

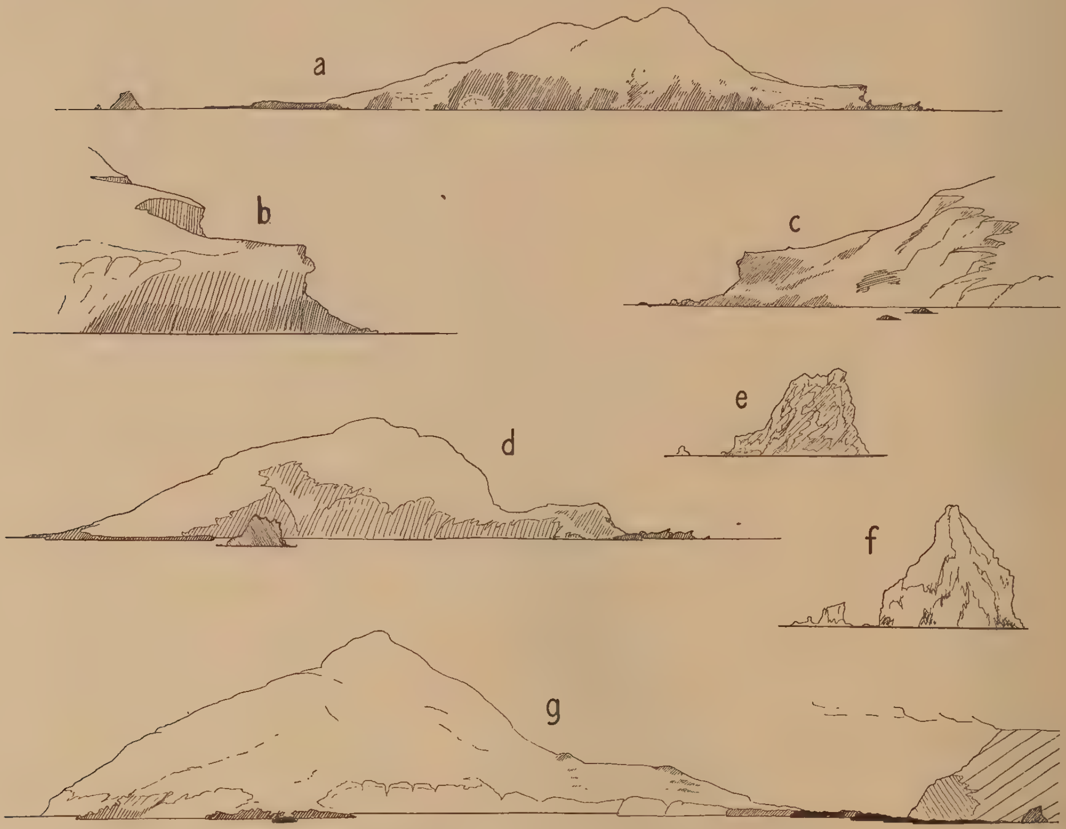

Fig. 21. Thule Island: sketches by Lt.-Cmdr. J. Irving.

a. From the E: Twitcher Rock on the left bearing 180°, distant 1·1 miles. Hewison Point is on the left of the island and Beach Point on the right.

b. Cape Flannery from the NW: bearing 147°, distant 8 cables.

c. Cape Flannery from the SE: bearing 326°, distant 1·5 miles.

d. From the ESE: Twitcher Rock in the foreground bearing 287°, distant 4 cables.

e. Twitcher Rock from the WNW: bearing 122°, distant 1·4 miles.

f. Twitcher Rock from the NNE: bearing 198°, distant 3 cables.

g. From the S, showing Ferguson Bay in the centre. Herd Point is on the left side of the bay; on the right is Twitcher Rock and part of Cook Island.

In 1911 a landing was effected in Ferguson Bay by members of a whaling expedition under Capt. Ole Jörgensen (see p. 141); here we ourselves attempted to go ashore but were unable to do so owing to the heavy swell. Near Beach Point, however, we were more successful, Dr E. H. Marshall and Mr T. J. Hart landing in a pram on a shore composed of pebbles and boulders. The seal on the beach were found to be mainly Weddell seal, about forty in all, together with two Elephant seal and several adult and one young of the Leopard seal. The beach is evidently a resort for Leopard seal during the breeding season, for it was littered with excreta containing penguin feathers. At Beach Point there is a rookery of Ringed penguins, with some patches of green vegetation similar to those seen on other islands. The plant proved to be an alga and has been identified by Mr G. Tandy as *Prasiola crispa*, a species of very wide distribution. Among the earth in which this plant was growing two species of mites and a single insect, a Collembolan, were found. A sample of "red snow" (*Chlamydomonas*) was taken. Some brackish pools, formed apparently by melted snow, appeared to be without life, but in mud scraped from the undersides of stones lying in the water some ciliate Protozoa were obtained. Geological specimens were collected, but unfortunately several of the most characteristic types of rock did not occur at Beach Point.

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APPENDIX

REPORT ON ROCK SPECIMENS FROM THULE ISLAND, SOUTH SANDWICH ISLANDS

By G. W. TYRRELL, A.R.C.Sc., D.Sc., F.G.S., F.R.S.E.
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The specimens, fifteen in number, were collected from the scarp at Beach Point (see the foregoing Report, pp. 188–9). Eight of them were obtained from rock *in situ* on the face of the cliff and at its summit. The remaining seven were beach pebbles. It is stated in the Report (p. 188) that the ridge is about 150 ft. in height, and is composed of hard grey rock with outcrops of red tuff, and a soft crumbling black rock, perhaps volcanic ash, at the summit. The specimens collected *in situ* bear out this description. From the labels attached to the material, and from the petrographical examination, the following additional facts have been elicited. Six specimens were obtained from a steep escarpment at about 50 ft. above sea level. Of these, four are dacite lavas with good flow structures, and two are pyroxene-andesites containing both monoclinic and orthorhombic pyroxenes. From the fact that a black slaggy andesitic lava with red crusts, diagnosed in the field as "tuff", was obtained at a height of 100 ft. above sea level, it is inferred that the upper part of the cliff, from the 100 ft. level at any rate, consists of a flow, or flows, of andesite lava, whilst the dacite specimens probably came from underlying flows. At the top of the cliff, 150 ft. above sea level, a true andesite tuff was obtained, which probably represents the final explosive discharge of the volcano after the andesite lava had been ejected.

The seven beach cobbles and pebbles consist mainly of dacites and andesites entirely similar to those found *in situ*. In addition there is a specimen of a basic type of andesite containing a notable amount of olivine, and one of andesitic pumice.

PETROGRAPHY.

The *dacites* (or dacitoids) are greyish green, reddish, or purplish, compact, non-porphyritic rocks, the colours of which obviously vary according to the state of oxidation of their iron. Colour streaks and bands, and a somewhat platy fracture, indicate a flow structure which is prominent in all specimens when seen in thin section.

Under the microscope these rocks are found to consist mainly of feldspar microlites which are arranged in more or less parallel streams indicating flow, embedded in a dense, irresolvable, cryptocrystalline base. The microlites are of plagioclase, and are referred to oligoclase as they give straight or nearly straight extinctions. The only other identifiable constituents of the ground-mass are minute spots and streaks of iron oxides which, when in the form of haematite or limonite, produce the prevailing purplish and reddish tints of the rocks. There are also tiny crystals of strong birefringence which may be identified as augite in coarser streaks and bands which are to be found in one of the specimens. Rare microphenocrysts of andesine (Ab_3An_2), which are sometimes euhedral, and sometimes curiously corroded, are the only other crystalline constituents of these rocks. Quartz does not appear, although the chemical analysis (see Table II, 1) discloses no less than 30 per cent of free silica.

Two of the slides show included fragments of a coarse-grained olivine-andesite consisting of plagioclase laths, elongated crystals of augite studded with granules of magnetite, and sporadic olivine, in a glassy ground-mass which has been partially devitrified with the production of ill-defined feldspathic material and quartz. The angularity of these xenoliths, and the fact that they have obviously chilled a surrounding zone of lava with the production of an opaque envelope of iron ores, indicate that they are fragments picked up by the lava as it flowed over the surface, and not cognate xenoliths brought up from great depths.

Table I

Analyses of Dacites, etc.

	1	A	B	C	D
SiO_2	69·45	67·71	66·39	69·56	66·9
Al_2O_3	14·20	14·65	17·62	15·65	16·6
Fe_2O_3	2·83	1·59	1·01	1·24	2·5
FeO	3·24	3·29	2·21	0·91	1·4
MgO	0·25	0·85	1·32	0·82	1·2
CaO	3·05	2·34	3·79	2·52	3·3
Na_2O	4·15	6·09	4·49	4·09	4·1
K_2O	1·51	1·99	2·13	2·19	2·5
H_2O+	0·40	0·16	0·39	2·92	1·1
H_2O-	0·60	—	—		
TiO_2	0·15	1·00	0·33	—	0·3
P_2O_5	0·14	0·16	—	0·13	0·1
MnO	0·07	—	—	—	0·04
(Ni, Co)O	Nil	—	—	—	—
CO_2	Nil	—	—	—	—
S	Trace	—	—	—	—
	100·04	99·83	99·68	100·03	100·04

1. Dacite (Dacitoid), Thule Island, South Sandwich Islands. Anal. F. Herdsman, A.R.S.M.

A. Hyalodacite ("Trachyte"), Deception Island, South Shetland Islands. Quoted from H. S. Washington, "Chemical Analyses of Igneous Rocks", *Prof. Paper* 99, *U.S. Geol. Surv.* pp. 242–3 (1917). Also see G. W. Tyrrell, *Trans. Roy. Soc. Edin.* LIII, pt 1, p. 71 (1921).

B. Quartz-diorite, dredged block from sounding in lat. 70° S, long. 81° W (Paris), West Antarctica. Quoted from H. S. Washington, *op. cit.* pp. 266–7.

C. Dacite, Guaitara Slope, Loma de Ales, Colombia. Quoted from J. P. Iddings, *Igneous Rocks*, II, p. 496 (1913).

D. Dacite, mean of thirty analyses. Quoted from G. W. Tyrrell, *Principles of Petrology*, p. 124 (1926).

The chemical analysis of a composite sample of three specimens of dacite lava from the 50 ft. cliff is given in Table I, 1. It is there compared with an analysis of the hyalodacite of Deception Island in the South Shetland group, which appears to be its closest affinity in the West Antarctic region (Table I, A). The analyses are closely comparable, although the Deception Island rock has higher total alkalies, and a higher ratio of soda to potash, than the Thule Island rock. The closest plutonic analogue to these dacitic lavas in the West Antarctic region is a quartz-diorite (Table I, B) from a dredged block. The most comparable Andean lava is a dacite from Colombia (Table I, C). The average dacite (Table I, D) compares closely with the rock under investigation, but is richer in potash relatively to soda, and is somewhat less siliceous.

The normative mineral compositions of these rocks, computed under the rules of the American Quantitative Classification, are set out in Table II. The Thule Island dacite is there shown to compare remarkably well with the average dacite (Table II, D), but is somewhat richer in quartz and poorer in orthoclase, features which are also shown by the Colombian dacite (Table II, C). The assignment of the Thule Island lava to the dacite group is therefore well founded; but since the quartz is mostly occult in the cryptocrystalline ground-mass, Lacroix's term *dacitoid*,[1] applied to rocks of this chemical character in which quartz is not mineralogically expressed, is more appropriate than dacite. On the evidence of the minerals actually seen in thin section, and without a corrective chemical analysis, this rock would probably have been called oligoclase-andesite.

Table II

Norms of Analyses in Table I.

	I	A	B	C	D
Quartz	31·4	18·5	20·9	30·5	24·9
Orthoclase	8·9	11·7	12·2	12·8	15·0
Albite	35·1	51·4	38·2	34·6	34·6
Anorthite	14·5	6·4	18·9	12·5	15·6
Corundum	0·4	—	1·0	2·0	1·4
Diopside	—	3·7	—	—	—
Hypersthene	4·0	3·3	5·9	2·8	3·0
Magnetite	4·2	2·3	1·4	1·6	3·7
Ilmenite	0·3	2·0	0·6	—	0·6
Apatite	0·3	0·3	—	0·3	0·3

The norms are arranged in the same order as the analyses in Table I. The symbols of these analyses in the American Quantitative Classification are given below:

I.	I	(3) 4	(2) 3	4
A.	I (II)	4	″2	4″
B.	I″	4	″3	4
C.	I	″4	2″	4
D.	I″	4	(2) 3	4

The *andesites* are hypersthene-augite-andesites usually containing a little olivine. In some specimens the olivine becomes a fairly prominent constituent, but without lessening the andesitic character of the rocks, and the term *olivine-andesite* may then be employed. Olivine-andesites, often called andesitic basalt, basaltic andesite, or simply basalt, are common in many andesitic lava fields. They are, however, easily distinguishable on chemical and mineralogical grounds from true basalts.

---

[1] *Comptes Rendus*, Paris, CLXVIII, p. 297 (1919).

The Thule Island andesites are dark grey or purplish grey compact rocks without conspicuous crystals, although many, very small, microporphyritic feldspar crystals may usually be detected on close inspection. Some of the specimens are highly vesicular or slaggy; one is pumiceous.

In thin section the analysed rock, collected from a shore boulder, shows numerous microphenocrysts of euhedral plagioclase, with much less abundant hypersthene and augite, and fresh but rare olivine, in a ground-mass consisting of minute laths of plagioclase feldspar, intermingled with grains of pyroxenes and iron ores. Only a very small amount of cryptocrystalline or glassy base is present. As a whole the rock is highly feldspathic, and is of andesitic, not basaltic, character, notwithstanding the presence of a little olivine. The phenocrystic feldspar is highly zonal, ranging from labradorite (Ab_2An_3) at the core to oligoclase on the margin. These feldspars also carry numerous inclusions of ground-mass constituents which are always arranged in regular zones with reference to the margins of the crystals. The ground-mass feldspar is of somewhat more sodic composition and seems to be mainly andesine of composition about Ab_3An_2. The hypersthene is faintly pleochroic; the augite, however, is practically colourless.

Other rocks of much the same character, but with a finer ground-mass, and considerably richer in an obscure glassy base, come from the 50 ft. escarpment, and from the slaggy lava surface (or base) at the 100 ft. level. One of the shore specimens may also be associated with this group, but shows in addition a well-marked flow structure. Another specimen from the 50 ft. escarpment shows the phenocrystic constituents embedded in red and black glassy matter which carries only a few scattered microlites of feldspar and pyroxene.

The olivine-andesites are represented by three beach pebbles. In their general characters these rocks conform very closely with the second type of andesite lava described above, but are somewhat richer in olivine which also occurs in larger crystals. A pebble of andesitic pumice in thin section shows a solidified froth of colourless isotropic glass in which scattered crystals of plagioclase, hypersthene and augite are entangled.

The tuff which occurs at the 150 ft. level at Beach Point is composed of little angular fragments of andesite and dacite, mostly of the more vitreous, slaggy, vesicular, and altered types, embedded in a paste consisting of comminuted particles of the same materials, mingled with a few angular grains of quartz, and detached feldspars.

In the only published account of rocks from the South Sandwich Islands O. Bäckström[1] has described rock types very similar to the above from Candlemas Island. He states that the lavas of Candlemas are mostly reddish porphyritic rocks in which the feldspar phenocrysts are occasionally so numerous as to produce a whitish appearance. The feldspar is a basic labradorite ($Ab_{35}An_{65}$), and the pyroxene is hypersthene with mantles of augite. The latter mineral also occurs independently. Corroded crystals of olivine are present in a few of the rocks, which Bäckström regarded as basalts transitional to andesites. From Saunders Island he described an "olivine-free basalt", consisting of plagioclase (with An$_{55-65}$), an almost colourless pyroxene of the enstatite-augite series, and magnetite. An analysis of this rock, which is reproduced in Table III, 1, was given. Hypersthene-andesites are common lavas in the Andes and in the South Shetland Islands.

---

[1] "Petrographische Beschreibung einiger Basalte von Patagonien, Westantarktika, und den Süd-Sandwich-Inseln", *Bull. Geol. Inst. Upsala*, XIII, pp. 115–82 (1915). South Sandwich Islands, pp. 163–76.

Table III

Analyses of Andesites, etc.

	1	2	A	B	C
SiO_2	52·68	54·90	57·30	61·80	59·2
Al_2O_3	16·38	17·62	17·97	18·65	16·8
Fe_2O_3	3·11	2·70	2·17	2·08	3·1
FeO	7·98	6·80	3·79	2·49	3·6
MgO	7·47	3·93	2·57	2·60	3·1
CaO	8·08	9·05	6·72	6·41	6·6
Na_2O	2·75	2·90	3·25	4·51	3·4
K_2O	0·44	0·54	0·96	0·82	1·7
H_2O+	0·20	0·30	4·26	0·25	1·1
H_2O-		0·20			
TiO_2	0·77	0·70	0·56	0·50	0·7
P_2O_5	0·02	0·09	0·20	0·18	0·2
MnO	0·16	0·23	—	0·08	0·2
(Ni, Co)O	—	Nil	—	—	—
CO_2	—	Nil	—	—	—
S	Trace	Trace	—	0·01	—
Cl	0·05	—	—	—	—
	100·09	99·96	99·75	100·66	99·7

1. "Olivine-free basalt", Saunders Island, South Sandwich Islands. Anal. N. Sahlbom. Quoted from O. Bäckström, *Bull. Geol. Inst. Upsala*, XIII, p. 173 (1915).
2. Hypersthene-andesite lava, Thule Island, South Sandwich Islands. Anal. F. Herdsman, A.R.S.M.

A. Hypersthene-andesite lava, Admiralty Bay, King George Island, South Shetland Islands. Anal. Lassieur. Quoted from H. S. Washington, "Chemical Analyses of Igneous Rocks", *Prof. Paper* 99, *U.S. Geol. Surv.* p. 419 (1917).

B. Hypersthene-andesite lava, Mt Burney, Patagonian Andes. Anal. G. Nyblom. Quoted from P. D. Quensel, *Bull. Geol. Inst. Upsala*, XI, p. 107 (1911).

C. Average hypersthene-andesite, computed from 114 analyses of rocks called hypersthene-andesite and pyroxene-andesite (containing hypersthene) from Recent and Kainozoic volcanoes and lava fields of the circum-Pacific region (including the East and West Indies), and certain European fields (Sardinia, Hungary, Aegean Sea).

A chemical analysis of the hypersthene-andesite of Thule Island by F. Herdsman is displayed in Table III, 2. It is there compared with the analysis of the "olivine-free basalt" of Saunders Island (1), the hypersthene-andesite of Admiralty Bay, King George Island, South Shetland Islands (A), and the hypersthene-andesite of Mt Burney (B), one of the southernmost volcanoes of the Andes. As a standard of comparison a new average analysis of hypersthene-andesite has been computed from 114 analyses found in Washington's compilation and more recent literature (C). This average hypersthene-andesite differs remarkably little from the average which was computed some years ago on the basis of 71 analyses, including, however, some pre-Kainozoic examples.[1]

---

[1] G. W. Tyrrell, "Some Tertiary Dykes of the Clyde Area," *Geol. Mag.* (6), IV, p. 310 (1917).

With the exception of the average analysis the analyses in Table III are arranged in order of increasing silica. With that increase there are concomitant decreases in ferrous iron, magnesia, and lime, increases in potash and soda, but with practically constant alumina, showing that the chemical variations within this group of andesites arise chiefly from variations in the relative proportions of the felsic and mafic groups of minerals. The lavas of the South Sandwich Islands are clearly among the more basic types of andesite, but are distinguishable from basalts by their richness in feldspars, the frequent presence of orthorhombic pyroxenes, and their comparatively high degree of supersaturation with silica (see the norms, Table IV, 1 and 2). The Saunders Island rock, however, is very near the borderline of the andesites and basalts. The South Shetland and Patagonian lavas are much closer to the average hypersthene-andesite, as is well shown by the norms (Table IV). A notable chemical feature of the hypersthene-andesites of the region under consideration is their poverty in potash as compared with the average hypersthene-andesite.

Table IV

Norms of Analyses in Table III.

	1	2	A	B	C
Quartz	3·6	9·2	15·1	14·7	14·3
Orthoclase	2·2	2·8	5·6	5·0	10·0
Albite	23·6	24·6	27·8	38·3	28·8
Anorthite	31·1	33·6	31·4	28·1	25·6
Diopside	7·4	8·7	0·9	2·2	5·1
Hypersthene	25·7	14·9	10·2	7·6	8·6
Magnetite	4·4	3·9	3·2	3·0	4·4
Ilmenite	1·5	1·4	1·1	0·9	1·4
Apatite	—	0·3	0·3	0·3	0·3

The norms are arranged in the same order as the analyses in Table III. The symbols of the rocks in the American Quantitative Classification are as follows:

1.	(II) III	5	4	″5
2.	II	4 (5)	4	(4) 5
A.	″II	4	(3) 4	4″
B.	(I) II	4″	3	(4) 5
C.	II	4″	3	4

The mineralogical variations corresponding to the above-described chemical variations are shown from left to right in the table of norms (Table IV) by the increasing free silica, increasing orthoclase, increasing ratio of albite to anorthite, with a concomitant decrease in the amount of pyroxenes. The norms also illustrate the curious fact, which was also pointed out in a former paper (Tyrrell, *op. cit. supra*, p. 311), that andesites which show no visible quartz may nevertheless contain up to 15 per cent. of free silica. They must therefore be derived from magmas which, under plutonic conditions, and with a little differentiation in the direction of further separation of mafic minerals, would give rise to such rocks as tonalite and quartz-diorite, namely, the plutonic types which occur most frequently in the cores of fold-mountain ranges such as the Andes in association with andesite lavas. This fact is worth emphasizing because andesites are frequently thought of as the volcanic representatives of the diorites only.

CONCLUSIONS.

The geology of the South Sandwich Islands, and its bearing on the disputed question of the tectonics of the "South Antillean Arc" of Suess, is discussed on p. 154 of this Report. The writer has also recently discussed the question in his paper on the petrography and geology of South Georgia,[1] in which he states that: "If Suess's homology of the Southern Antillean loop with that of the Caribbean Antilles were complete, the Andean type of volcano erupting andesitic lavas, and batholithic masses of the typical Cordilleran andendiorites and granodiorites in the cores of the mountain chains, should be present. They are, however, entirely wanting, with the possible exception of the South Sandwich Islands, about which the geological information is very scanty". The typical Andean lavas described in this Report therefore go far to support Suess's view of the tectonic relations of the "Southern Antilles". The writer has also pointed out (*op. cit. supra*, p. 53) that the South Sandwich Islands, according to O. Pratje's map,[2] are situated on an arcuate ridge which, to the east, is followed by a profound but narrow deep, and that, in its turn, by another narrow submarine ridge, both of which run parallel to the arc of the South Sandwich Islands. Hence in all probability we have here two parallel arcs of folding separated by a deep. These facts, which are supported by the statement in this Report (p. 154) that the echo soundings taken during the Expedition show conclusively that most of the submerged portions of the South Antillean Arc can still be traced in the relief of the sea bottom, therefore seem to indicate an enormous protrusion of circum-Pacific tectonic structures, accompanied by circum-Pacific lava types, for 1500 miles into the heart of the alien tectonic region of the Southern Atlantic Ocean, conditions which are found nowhere else in the whole vast extent of the Atlantic Ocean except in the Caribbean region.

[1] '*Quest*' *Expedition Report*, *British Museum* (*Nat. Hist.*), chapter III (1930). See especially pp. 51–4.

[2] O. Pratje, "Beitrag zur Bodengestaltung des Südatlantischen Ozeans", *Centr. f. Min.* Abt. B, pp. 129–52, Map, p. 132 (1928).

PLATES XI—XXXI

Plates XII, XIV, XVI, XIX, XXII, XXIV, XXVII are based on running surveys by Sub-Lieut. A. L. Nelson, R.N.R. Echo soundings taken by H. F. P. Herdman, M.Sc., and other members of the Scientific Staff.

PLATE XI

Chart of the South Sandwich Islands, showing in black the positions of the islands as determined during the survey of the R.R.S. 'Discovery II'. The positions and outlines assigned to the islands by Cook and Bellingshausen are shown in red and blue respectively, and are taken from Admiralty Chart Misc. 32, compiled from original sources by Lt.-Cmdr. R. T. Gould, R.N. (retd.).

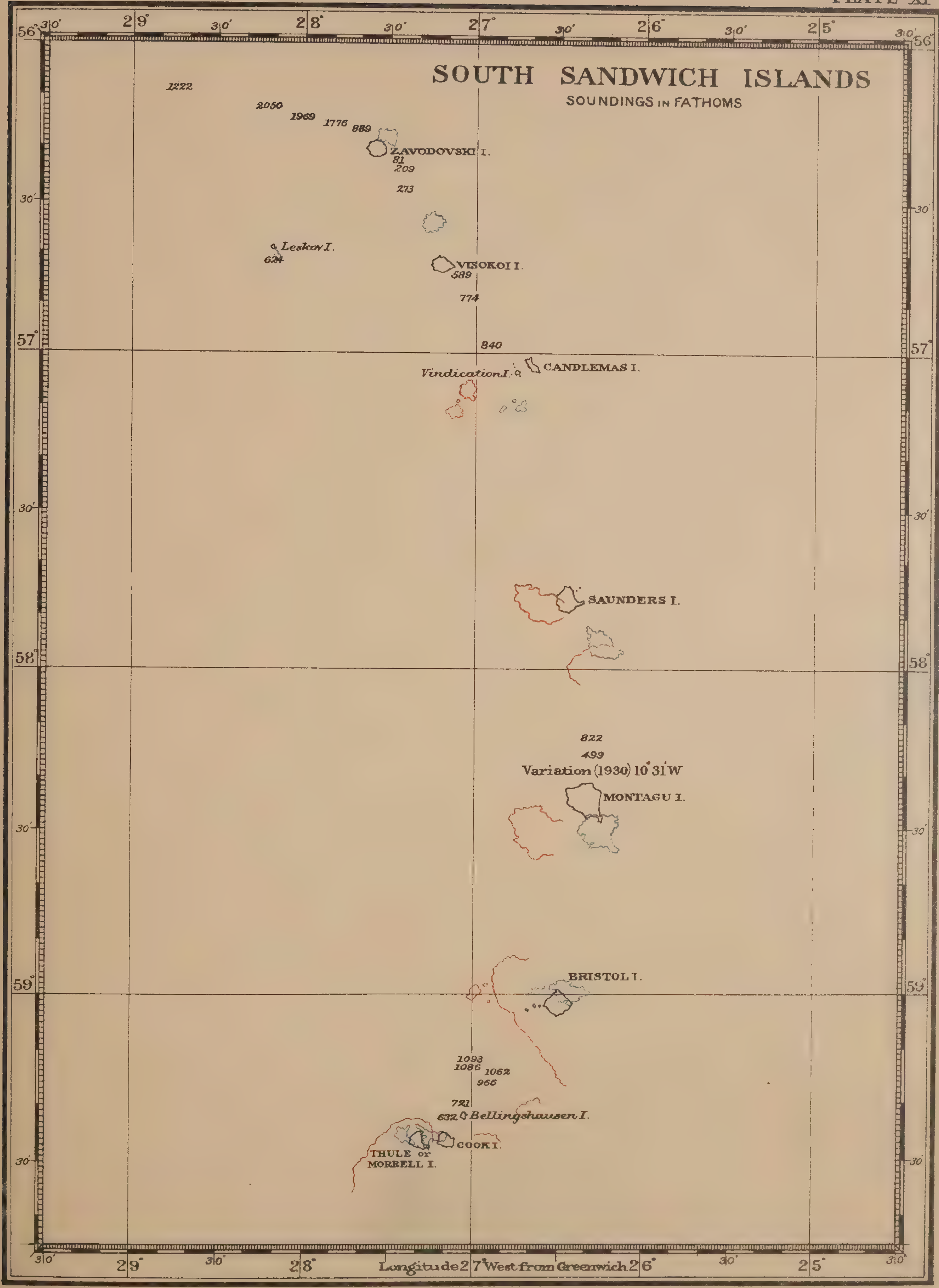

SOUTH SANDWICH ISLANDS
SOUNDINGS IN FATHOMS
1222
2050
1969
1776
889
ZAVODOVSKI I.
81
209
273
Leskov I.
624
VISOKOI I.
589
774
840
Vindication I.
CANDLEMAS I.
SAUNDERS I.
822
499
Variation (1930) 10° 31' W
MONTAGU I.
BRISTOL I.
1093
1086
1062
966
721
632
Bellingshausen I.
COOK I.
THULE or MORRELL I.
56°
57°
58°
59°
30'
29°
28°
27°
26°
25°
Longitude 27° West from Greenwich

PLATE XII

Chart of Zavodovski Island.

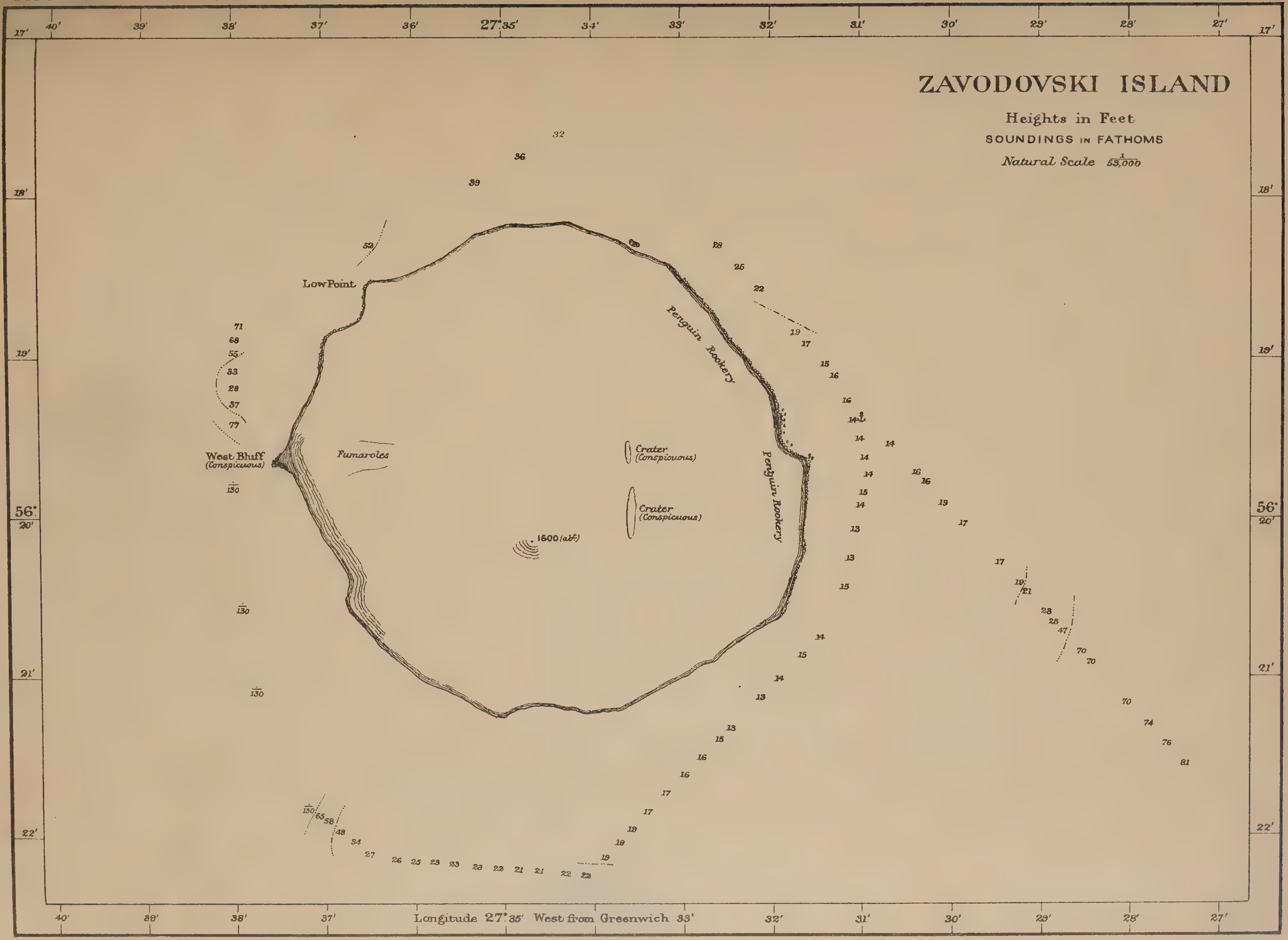

ZAVODOVSKI ISLAND
Heights in Feet
SOUNDINGS IN FATHOMS
Natural Scale $\frac{1}{53,000}$
Low Point
Penguin Rookery
Penguin Rookery
Crater (Conspicuous)
Crater (Conspicuous)
Fumaroles
West Bluff (Conspicuous)
1600 (abt.)
Longitude 27° 35′ West from Greenwich 33′
56° 20′
17′
18′
19′
21′
22′
40′
39′
38′
37′
36′
34′
32′
31′
30′
29′
28′
27′

PLATE XIII

Zavodovski Island (p. 158)

Fig. 1. The central part of the island seen from the E: the summit bearing 242°, distant 2·2 miles. Below the cloud of steam and vapour, the end of the long fissure which reaches to the top of the cone can be seen. Some of the dark patches on the lower slopes are subsidiary craters; the plateau in the foreground is warm and devoid of snow.

Fig. 2. Part of the island seen from the SSE. On the left is West Bluff, bearing 343°, distant 2·6 miles. In the foreground is the southern end of the basalt plateau, with the steep western cliffs seen on the left. Note that snow can only lie on the eastern side of the cone.

Fig. 3. Part of the island seen from the W. West Bluff is in the foreground to the left of the middle, bearing 143° and distant 5 cables. Above the headland is the opening of the main crater, with clouds of steam and sulphurous vapour rising. On the hill-side to the right a fumarole can be seen.

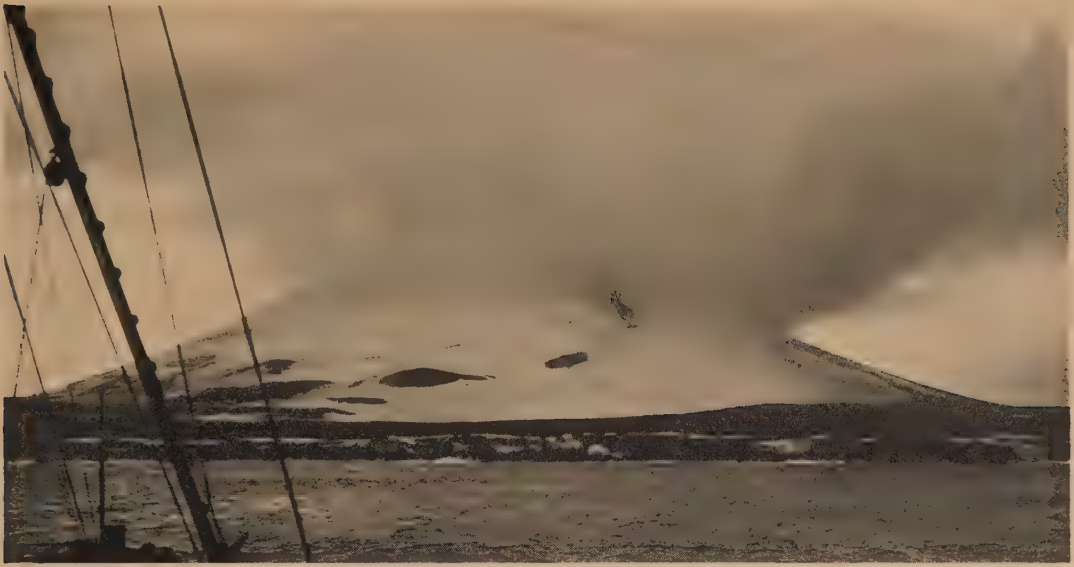


Fig. 1.

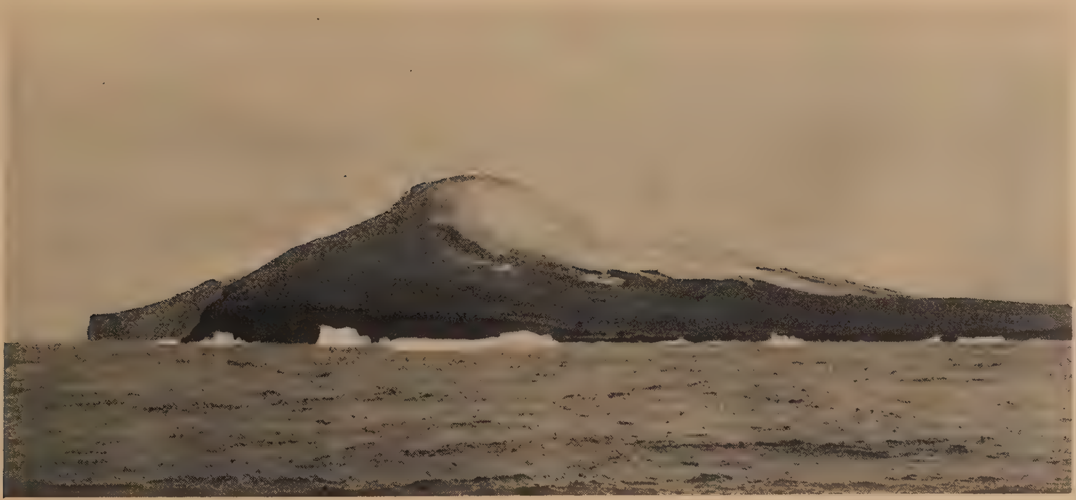
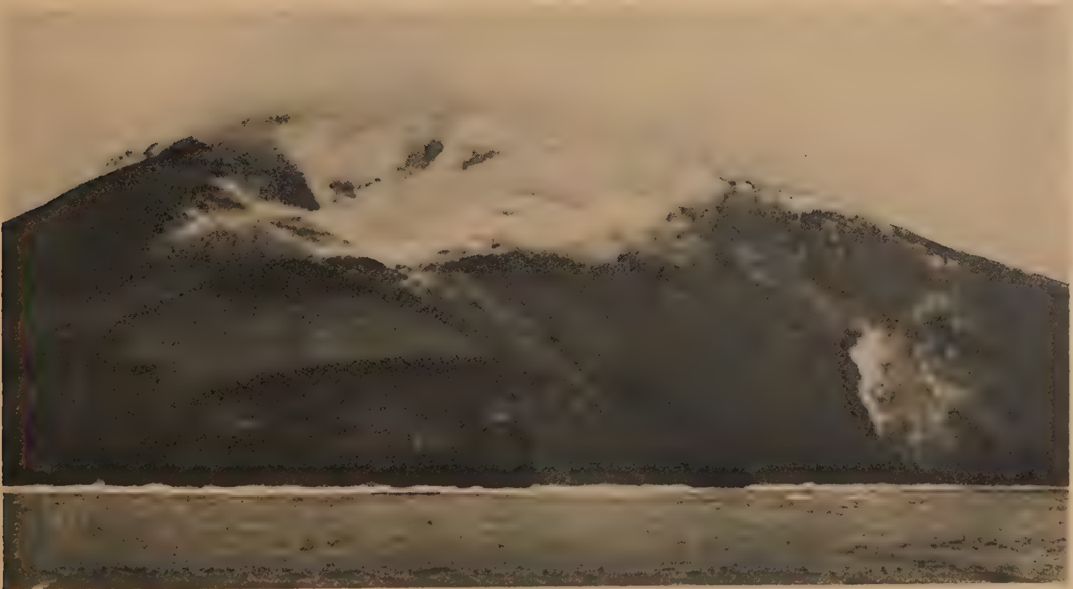


Fig. 2.



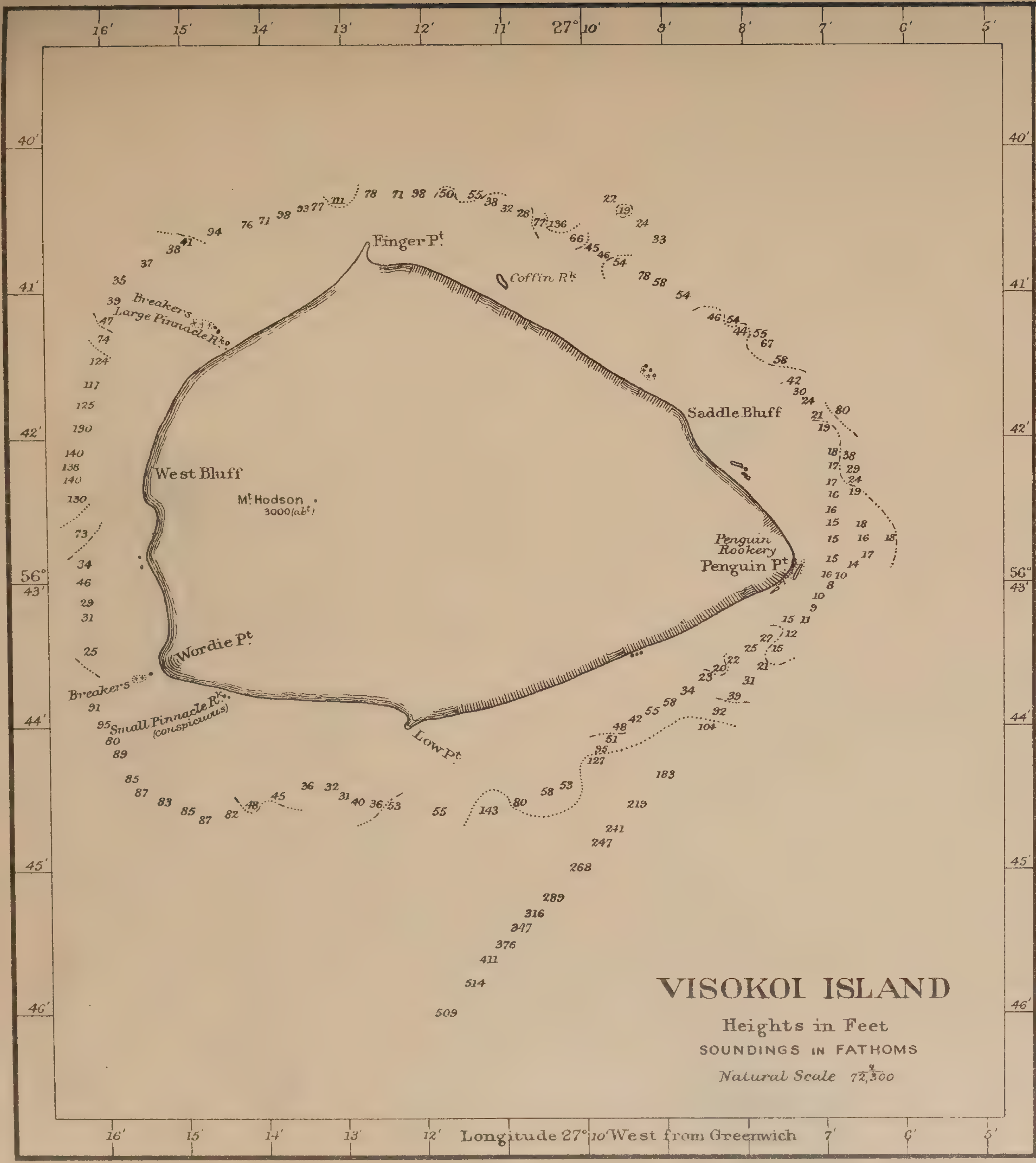
E. H. Marshall phot.

Fig. 3.

ZAVODOVSKI ISLAND

PLATE XIV

Charts of Visokoi Island and Leskov Island



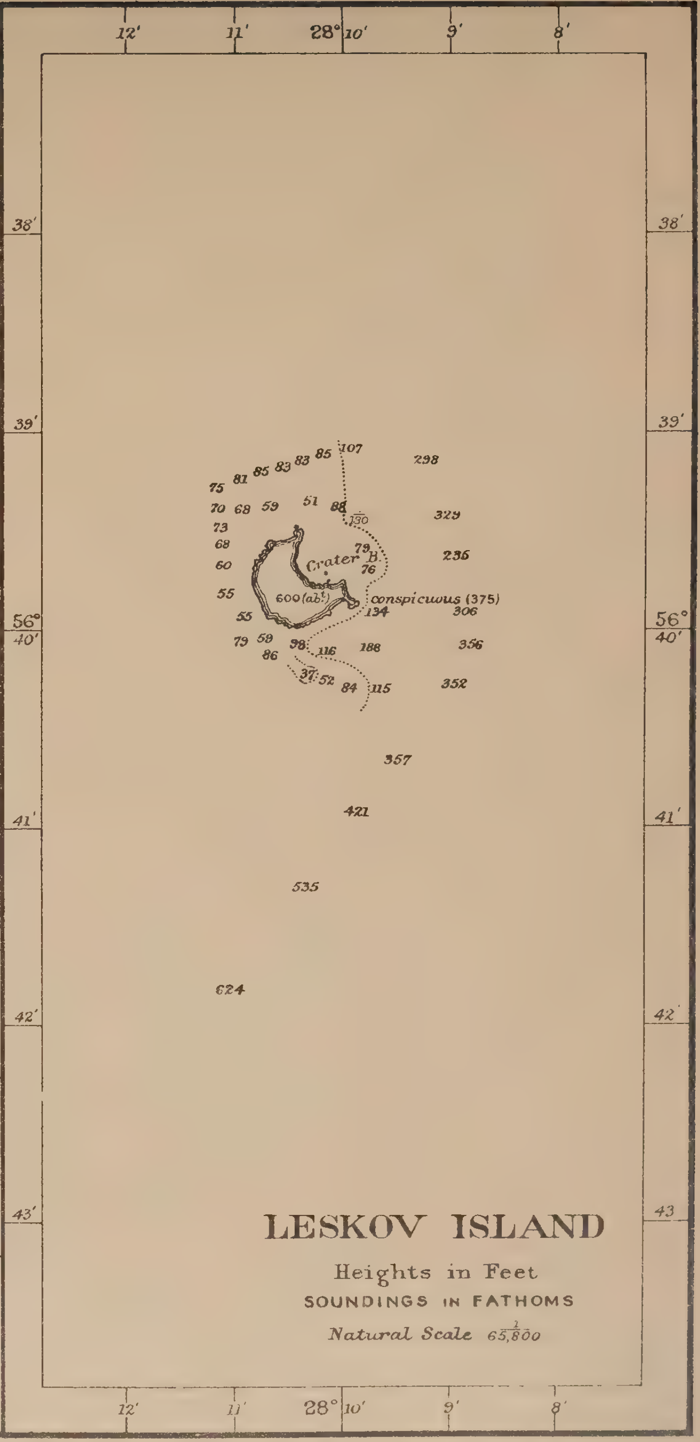
VISOKOI ISLAND

Heights in Feet

SOUNDINGS IN FATHOMS

Natural Scale $\frac{1}{72,300}$

Finger Pt.
Coffin Rk.
Saddle Bluff
Penguin Rookery
Penguin Pt.
Low Pt.
Wordie Pt.
West Bluff
Mt. Hodson 3000 (abt.)
Breakers
Large Pinnacle Rk.
Small Pinnacle Rk. (conspicuous)
Longitude 27° 10' West from Greenwich
56° 43'



LESKOV ISLAND

Heights in Feet

SOUNDINGS IN FATHOMS

Natural Scale $\frac{1}{65,800}$

Crater
B
600 (abt.)
conspicuous (375)
28° 10'
56° 40'

PLATE XV

Leskov Island (p. 161)

Fig. 1. The conical rock at the south-east corner of the island seen from the WSW: the summit of the rock bearing 065°, distant 5 cables. The rock is 375 ft. high and is formed of columnar basalt.

Visokoi Island (p. 162)

Fig. 2. Part of the island seen from the E. Penguin Point is to the right of the centre and is the site of a large penguin rookery; it bears 250°, distant 6 cables. On the right the surface of the glacier is much blackened by dust and debris.

Fig. 3. Glacier face on the south-eastern side of the island, showing ridges and pinnacles of ice probably caused by radiation from dust particles.

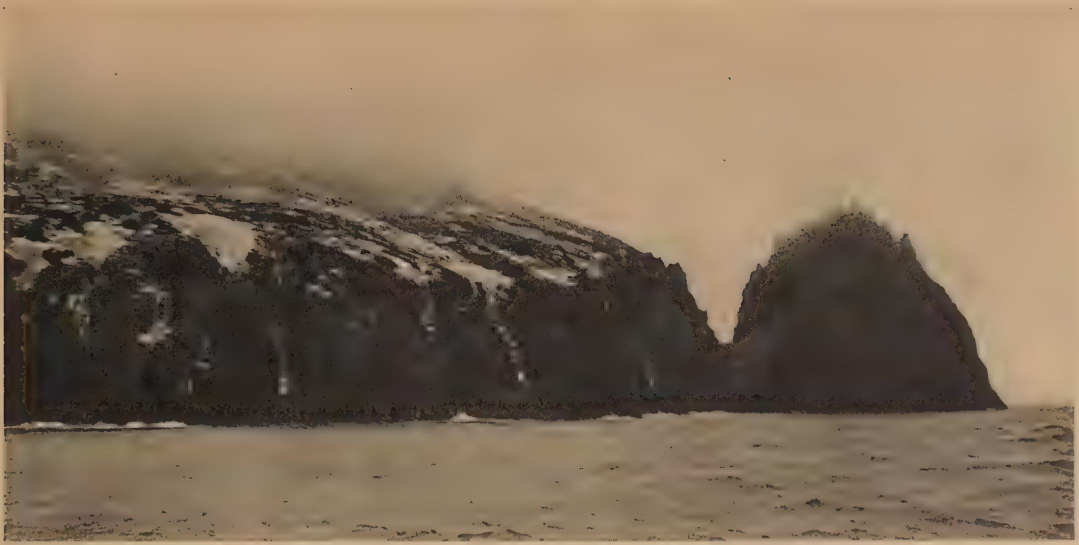


Fig. 1.

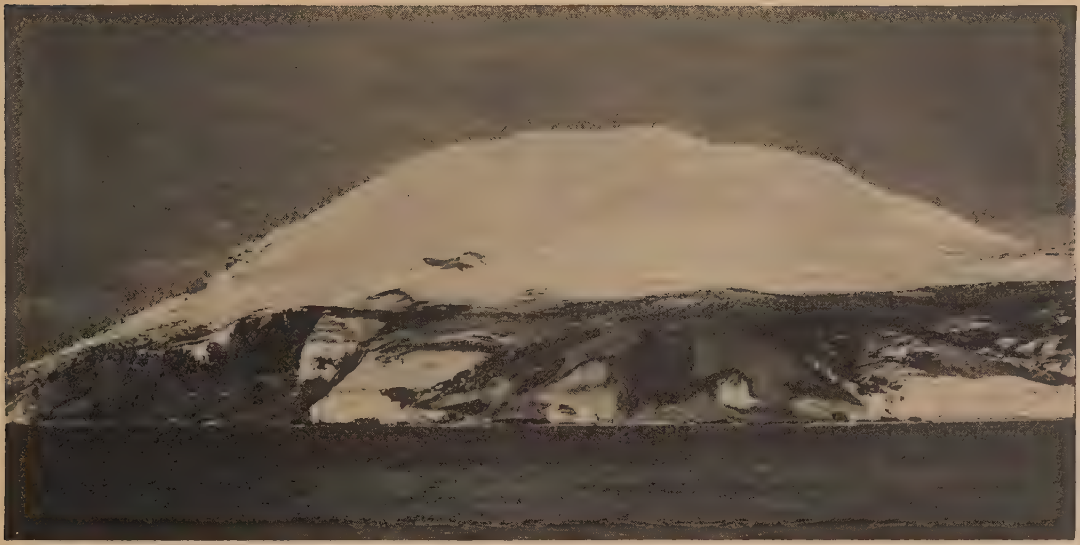
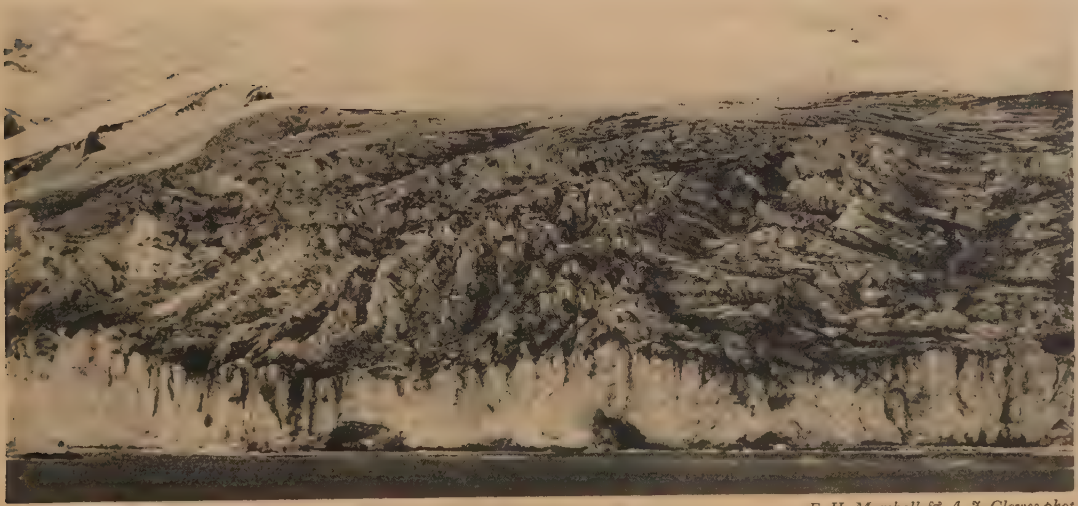


Fig. 2.



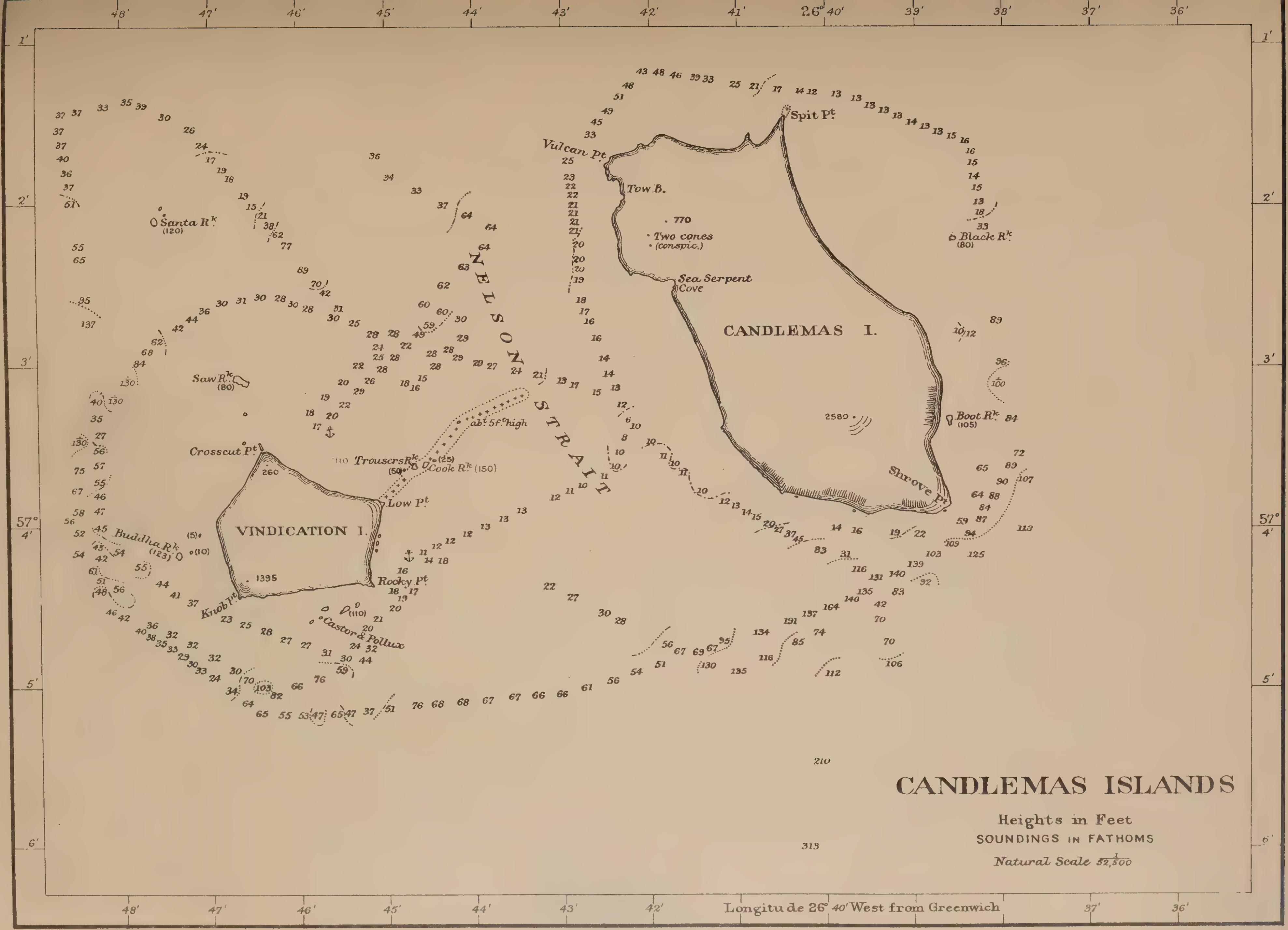
E. H. Marshall & A. J. Clowes phot.

Fig. 3.

LESKOV AND VISOKOI ISLANDS

PLATE XVI

Chart of Candlemas Islands


CANDLEMAS I.
VINDICATION I.
NELSON STRAIT
Spit Pt.
Vulcan Pt.
Tow B.
770
Two cones (conspic.)
Sea Serpent Cove
2580
Black Rk. (80)
Boot Rk. (105)
Shrove Pt.
Santa Rk. (120)
Saw Rk. (80)
Crosscut Pt.
260
Trousers Rk. (50)
Cook Rk. (150)
(25)
abt. 5ft. high
Low Pt.
Rocky Pt.
1395
Knob Pt.
Buddha Rk. (123)
(5)
(10)
(110)
Castor & Pollux
48′
47′
46′
45′
44′
43′
42′
41′
26° 40′
39′
38′
37′
36′
1′
2′
3′
57° 4′
5′
6′
Longitude 26° 40′ West from Greenwich

CANDLEMAS ISLANDS

Heights in Feet
SOUNDINGS IN FATHOMS
Natural Scale $\frac{1}{52,500}$

PLATE XVII

Candlemas Island (p. 168)

Fig. 1. The island seen from the NW at a distance of about 5 miles. At the back are seen the high glaciated summits of the south-eastern part of the island; in front the north-eastern basaltic plateau with its active volcanic cone.

Fig. 2. The rocks in Nelson Strait seen from the N, distant 8 cables. On the left is Cook Rock; Trousers Rock, showing an arch, is in the centre; on the right is Low Point, Vindication Island.

Fig. 3. Rocks of columnar basalt on the shores of Tow Bay.

Vindication Island (p. 170)

Fig. 4. Crosscut Point seen from the NNE: the point bearing 205°, distant 1 mile. The projecting points on the headland are of hard rock, intruded as dykes in the softer tuffs which compose the greater part of the island.

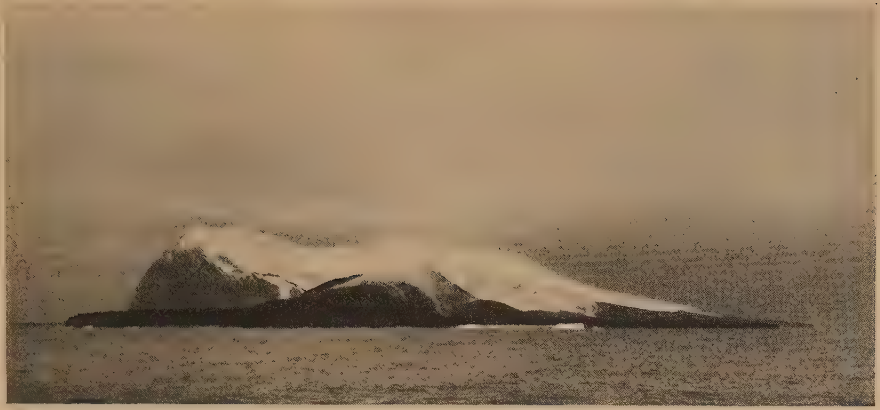


Fig. 1.

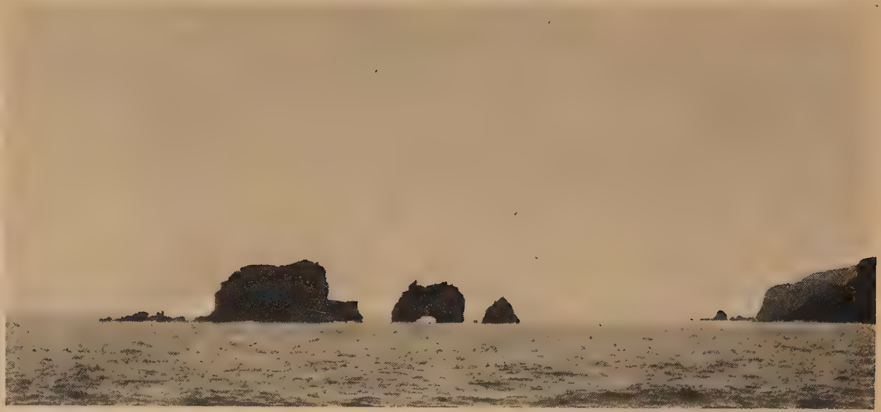


Fig. 2.

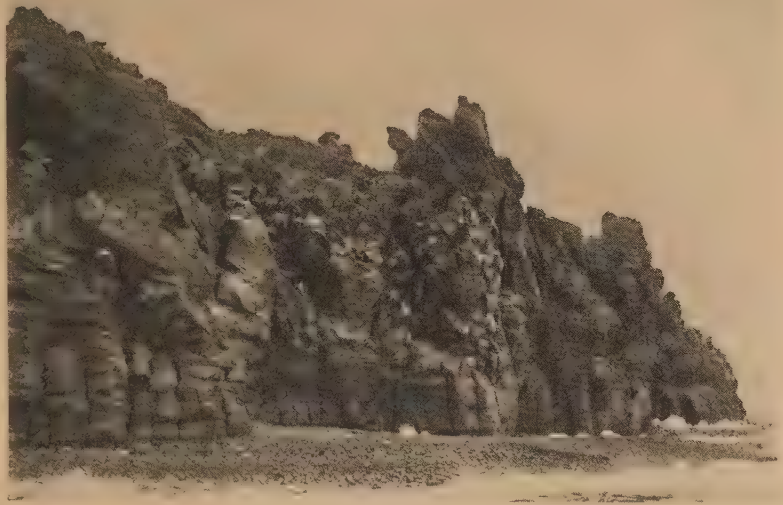
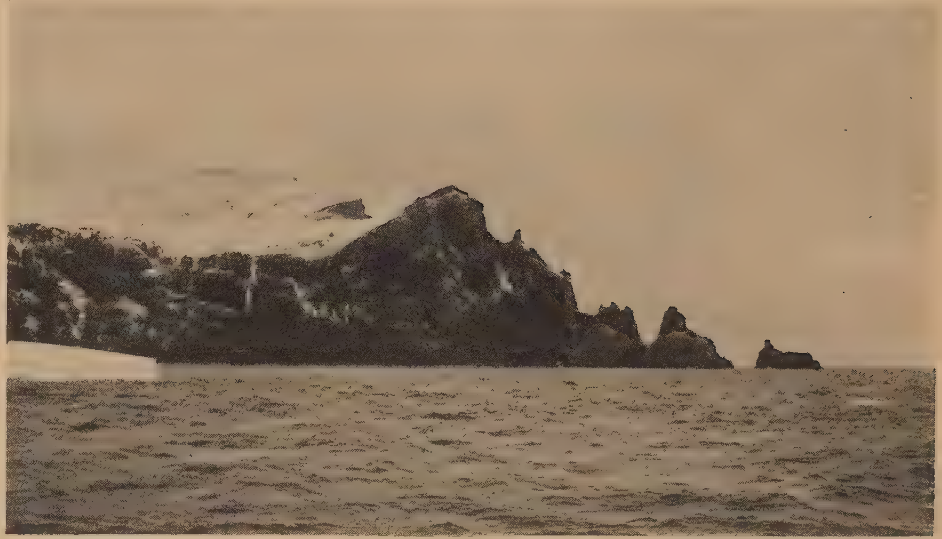


Fig. 3.



E. H. Marshall & F. C. Fraser phot.

Fig. 4.

CANDLEMAS AND VINDICATION ISLANDS

PLATE XVIII

Candlemas Island (*cont.*)

Fig. 1. Part of the south-eastern side of the island near Shrove Point, seen from the NE, distant 4 cables. Showing glacier breaking away at the water's edge.

Fig. 2. Shrove Point with its covering of glacier seen on the right. In the distance is Vindication Island, its northern (right-hand) point bearing 280°.

Vindication Island (*cont.*)

Fig. 3. The island seen from the E, the summit bearing 295°, distant $2\frac{1}{2}$ miles. On the left are Castor and Pollux Rocks and Knob Point; Low Point is on the right.

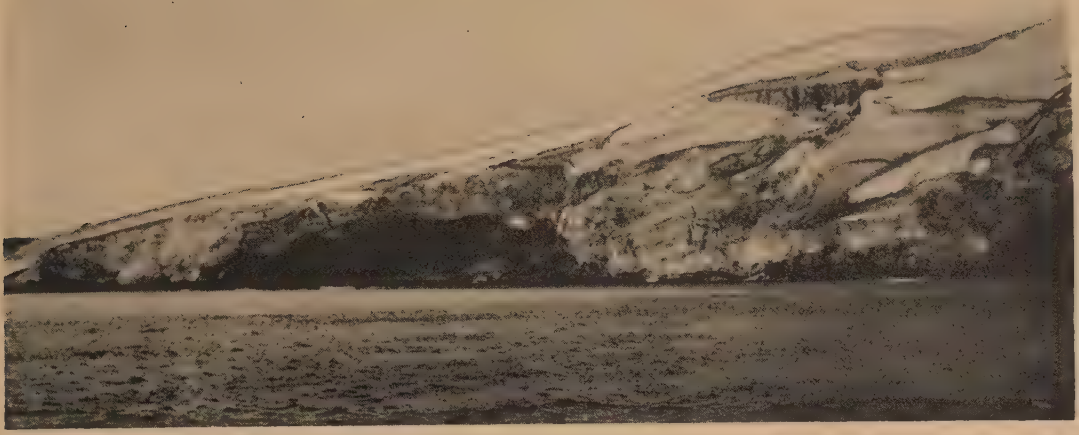


Fig. 1.

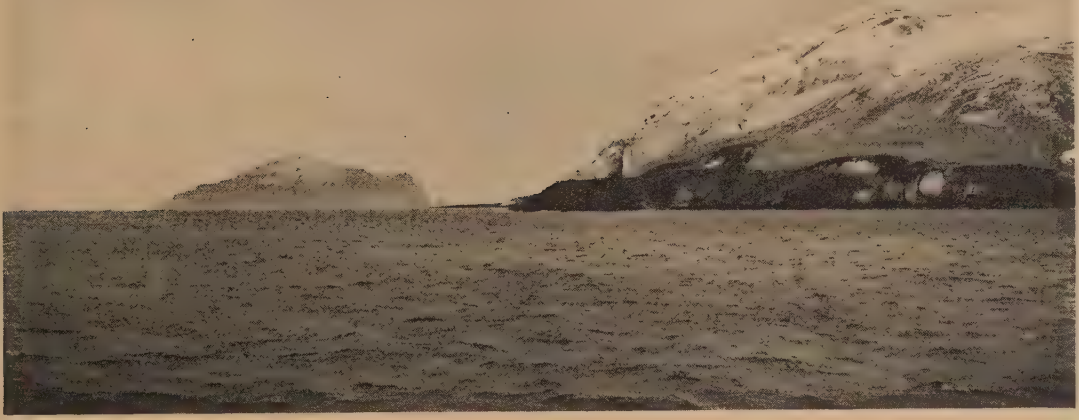
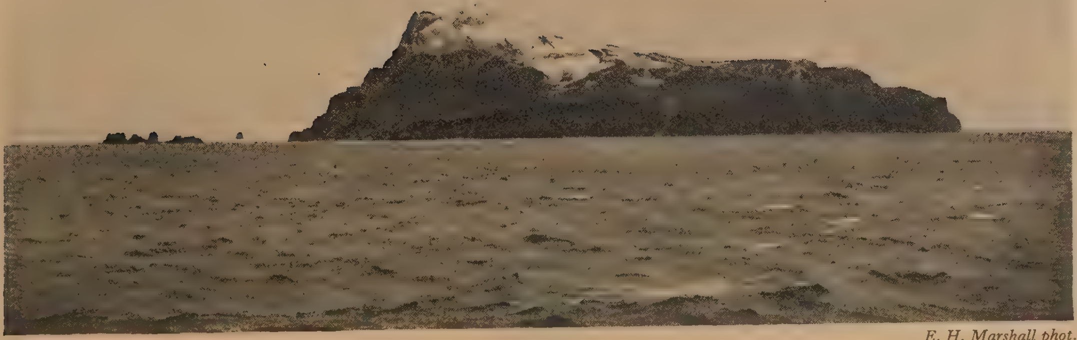


Fig. 2.



E. H. Marshall phot.

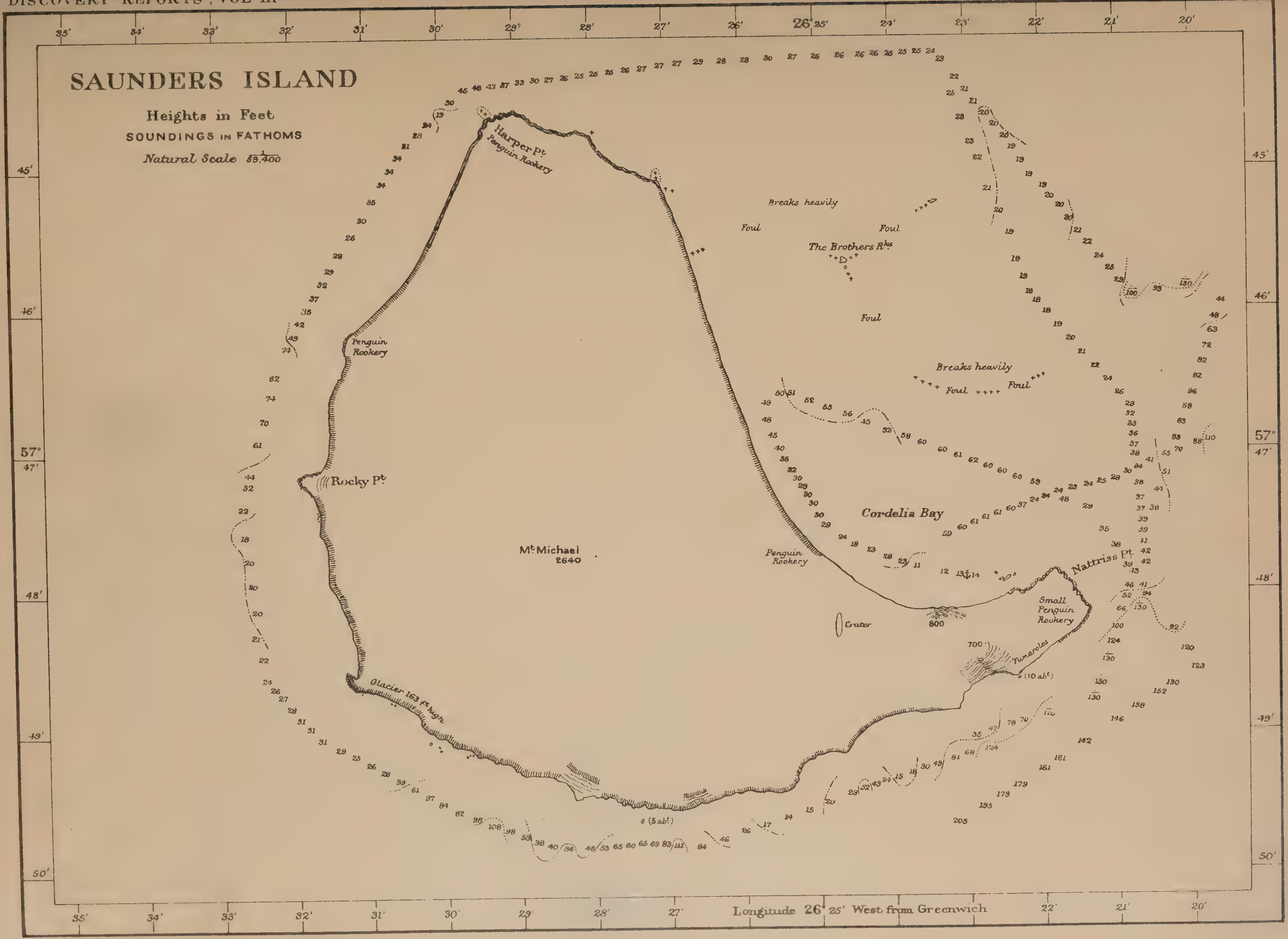
Fig. 3.

CANDLEMAS AND VINDICATION ISLANDS

XIX Classe

PLATE XIX

Chart of Saunders Island.



SAUNDERS ISLAND

Heights in Feet
SOUNDINGS IN FATHOMS
Natural Scale $\frac{1}{59,400}$

Harper Pt
Penguin Rookery
Breaks heavily
Foul
The Brothers Rks
Foul
Foul
Breaks heavily
Foul
Foul
Penguin Rookery
Rocky Pt
Mt Michael 2640
Cordelia Bay
Penguin Rookery
Nattriss Pt
Small Penguin Rookery
Crater
800
700
Fumaroles
(10 abt)
Glacier 163 ft high
(5 abt)
57°
45'
46'
47'
48'
49'
50'
35'
34'
33'
32'
31'
30'
29'
28'
27'
26'
26° 25'
24'
23'
22'
21'
20'
Longitude 26° 25' West from Greenwich

PLATE XX

Saunders Island (p. 172)

Fig. 1. The active volcano of Mt Michael, seen from Cordelia Bay: the summit bearing 250°, distant 2½ miles.

Fig. 2. The southern side of the eastern promontory of the island, showing a section of a crater, formed in volcanic mud or ash and exposed by a fall of the cliff. View taken from the SE, the peak to the right of the crater bearing 310°, distant 7 cables.

Fig. 3. A nearer view of this section of a crater, distant 3½ cables, showing the radial grooves formed on its surface by melting snow.

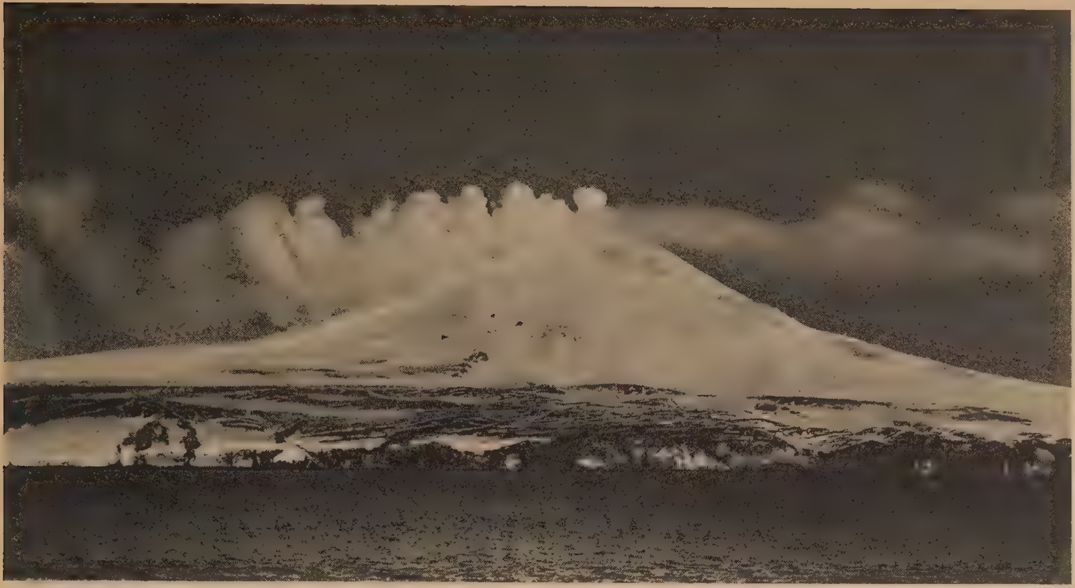


Fig. 1.

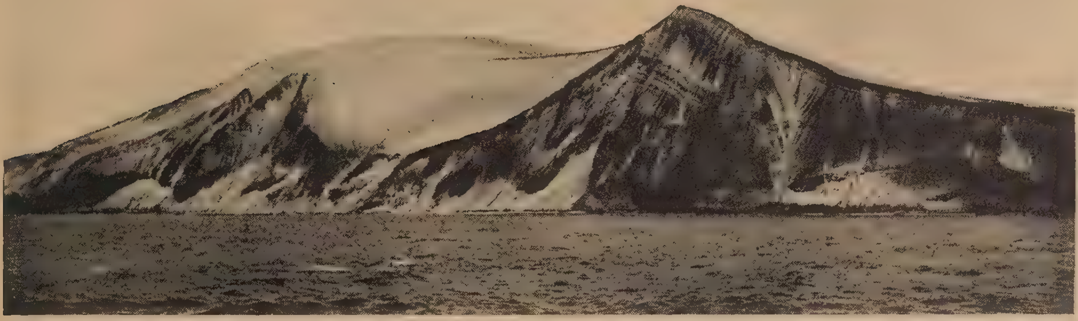
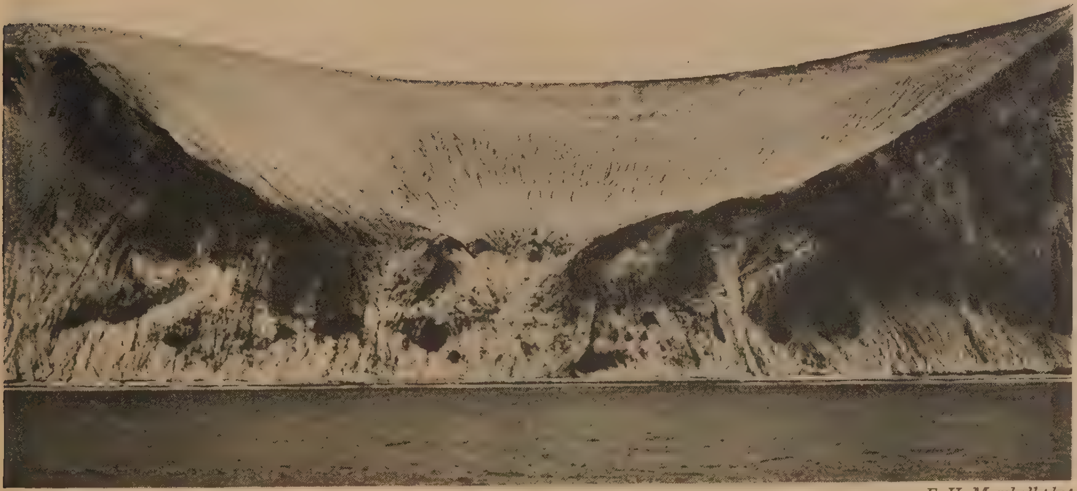


Fig. 2.



E. H. Marshall phot.

Fig. 3.

SAUNDERS ISLAND

PLATE XXI

Saunders Island (*cont.*)

Fig. 1. Distant view of the island from the N. On the left the bare hills forming the south-eastern promontory: on the right the glaciated cone of Mt Michael. The Brothers Rocks, seen opposite the left-hand termination of the glacier, bearing 190°, distant 2 miles.

Fig. 2. A large crater, apparently extinct, seen across the southern slopes of Mt Michael at a distance of about 9 cables. In Fig. 1 this crater lies behind the Brothers Rocks.

Fig. 3. A nearer view of the bare hills on the left of Fig. 1, taken from the NE. These hills are formed of volcanic mud or ash; owing to their warmth snow is rapidly melted and has scored deep runnels and ravines in their surface.

Fig. 4. Nattriss Point, at the south-eastern end of the island, taken from the N. This point, seen also on the extreme left of Fig. 1, stands on a platform of columnar basalt, and bears 180°, distant 5 cables.

Fig. 5. A small mound of warm mud protruding through the glacier at a point to the west of the bisected crater shown in Pl. XX, fig. 2. The melting snow has carried runnels of mud towards the sea over the surface of the glacier. View taken from the ESE at a distance of about half a mile.

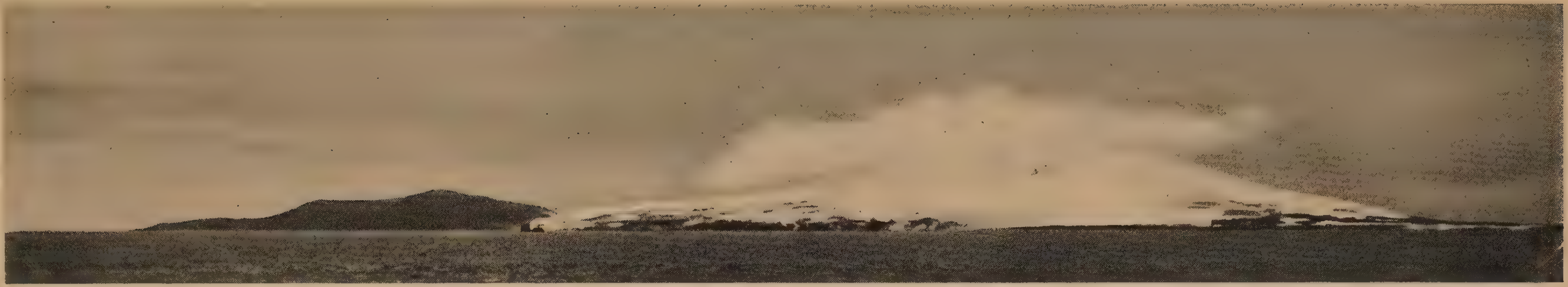


Fig. 1.

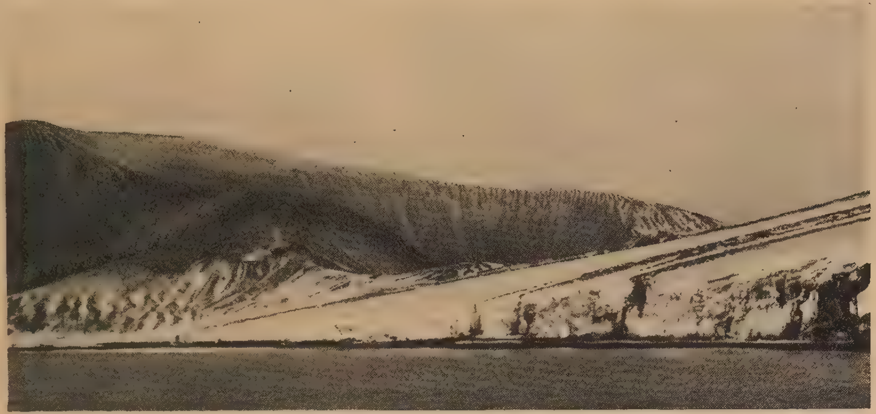


Fig. 2.

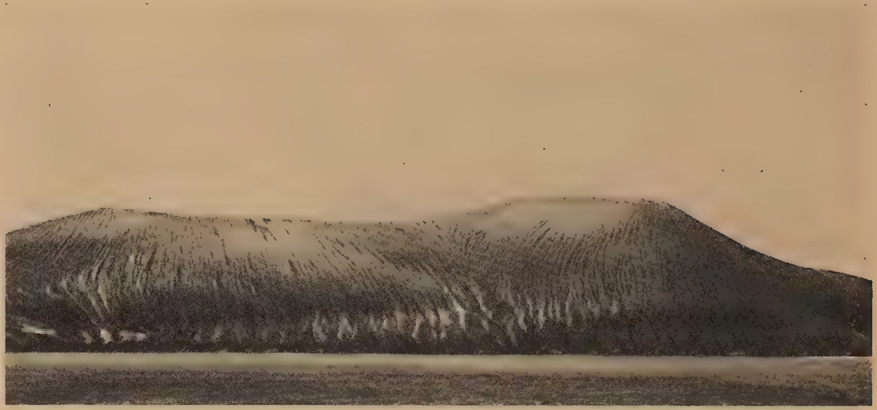


Fig. 3.

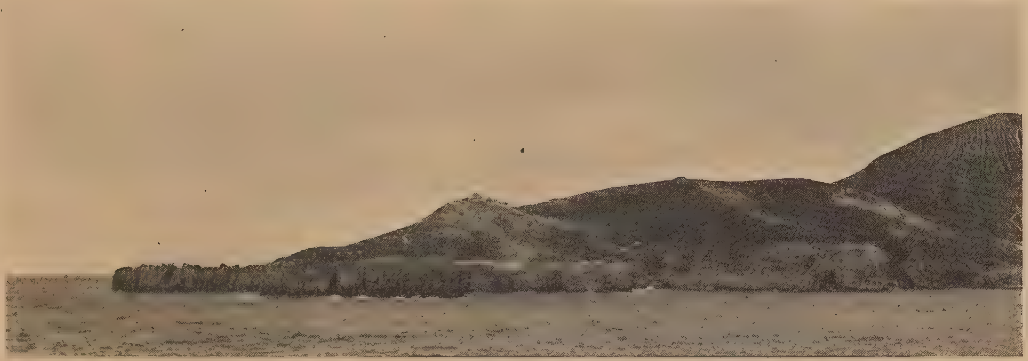
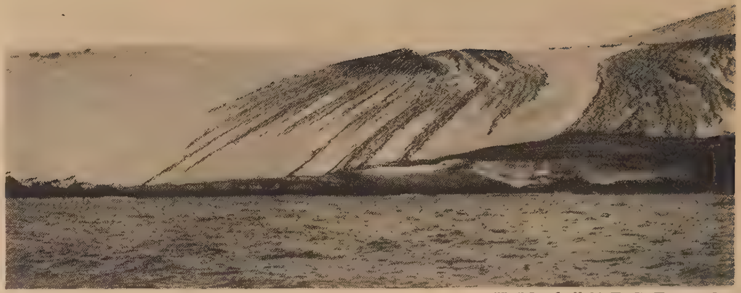


Fig. 4.



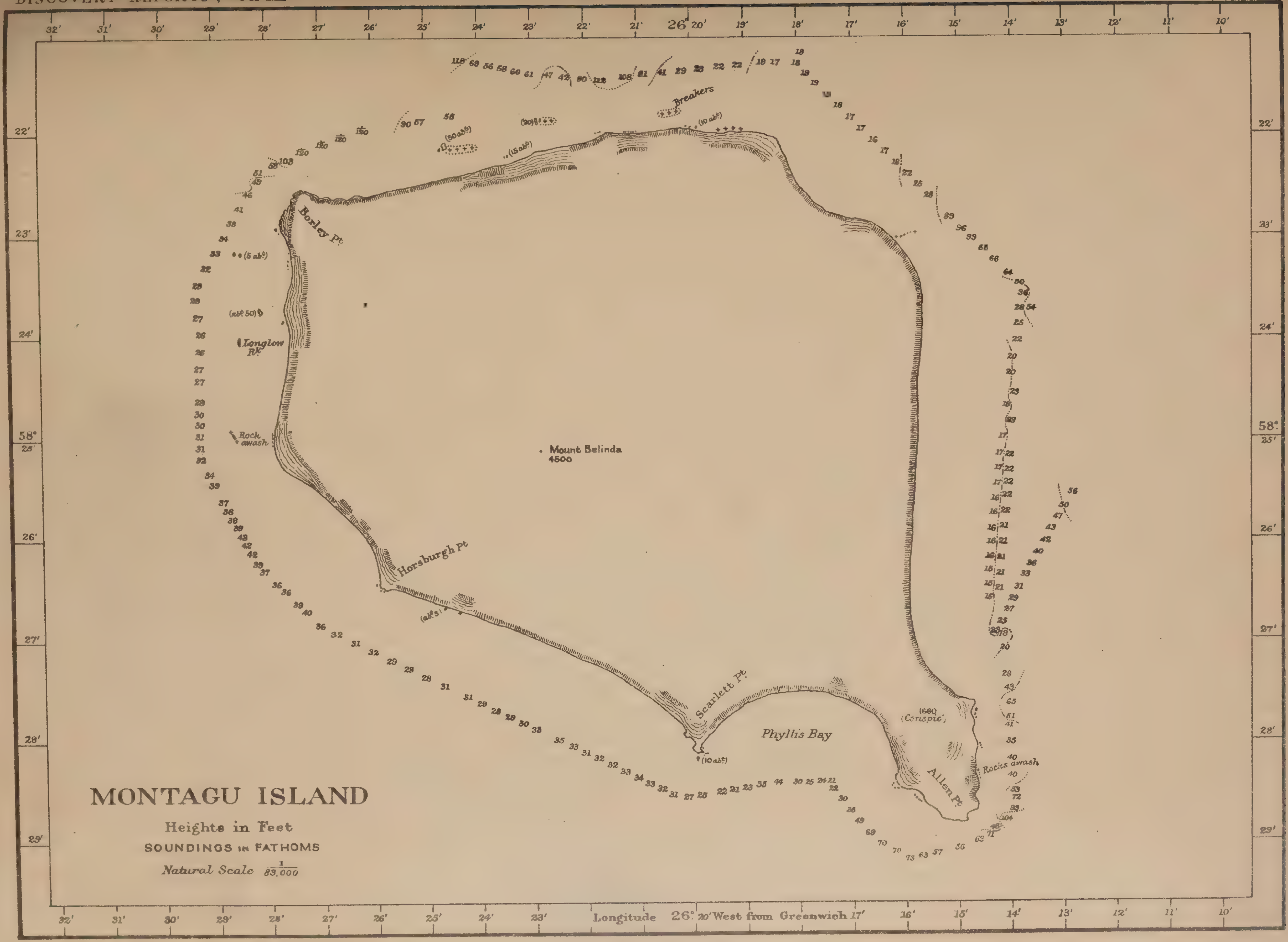
E. H. Marshall & F. C. Fraser phot.

Fig. 5.

SAUNDERS ISLAND

PLATE XXII

Chart of Montagu Island


Borley Pt
Longlow Rk
Rock awash
Horsburgh Pt
Scarlett Pt
Phyllis Bay
Allen Pt
Rocks awash
(680) (Conspic)
Breakers
Mount Belinda 4500
58° 25'
Longitude 26° 20' West from Greenwich

MONTAGU ISLAND

Heights in Feet
SOUNDINGS IN FATHOMS
Natural Scale $\frac{1}{83,000}$

PLATE XXIII

Montagu Island (p. 174)

Fig. 1. The conical hill, 1660 ft. high, at the south-east corner of the island: the summit bearing 000°, distant 1·3 miles. There are indications at several points that this promontory still retains some of its volcanic heat.

Fig. 2. The north-eastern end of the island, seen from the NNW at a distance of 6 cables, showing rock exposures and a glacier falling in broken masses of ice to the sea-level.

Fig. 3. Part of the northern side of the island, viewed from the N and distant 5 cables, showing cliffs and a hanging glacier.

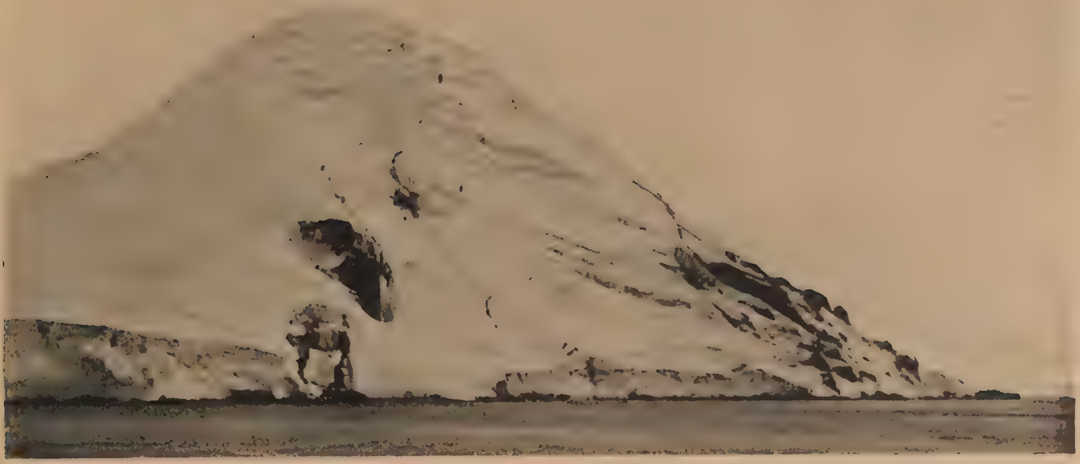


Fig. 1.

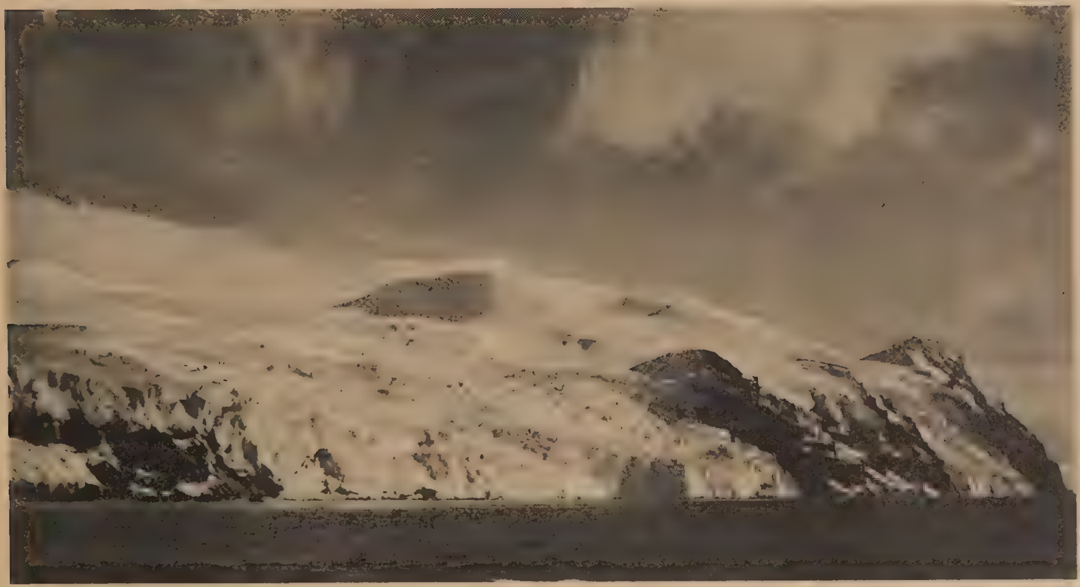
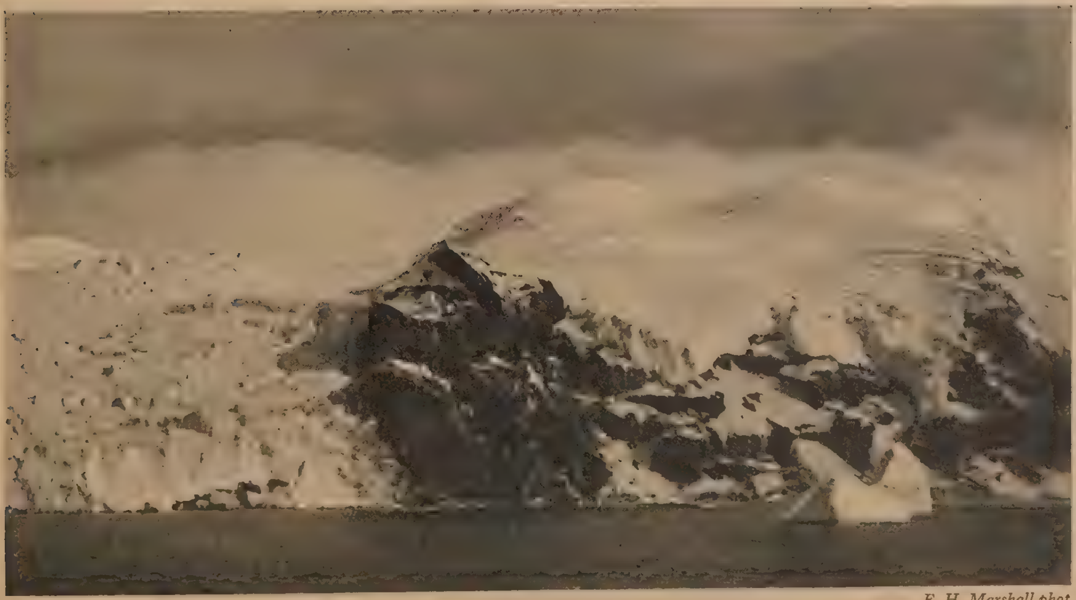


Fig. 2.



E. H. Marshall phot.

Fig. 3.

MONTAGU ISLAND

PLATE XXIV

Chart of Bristol Island.

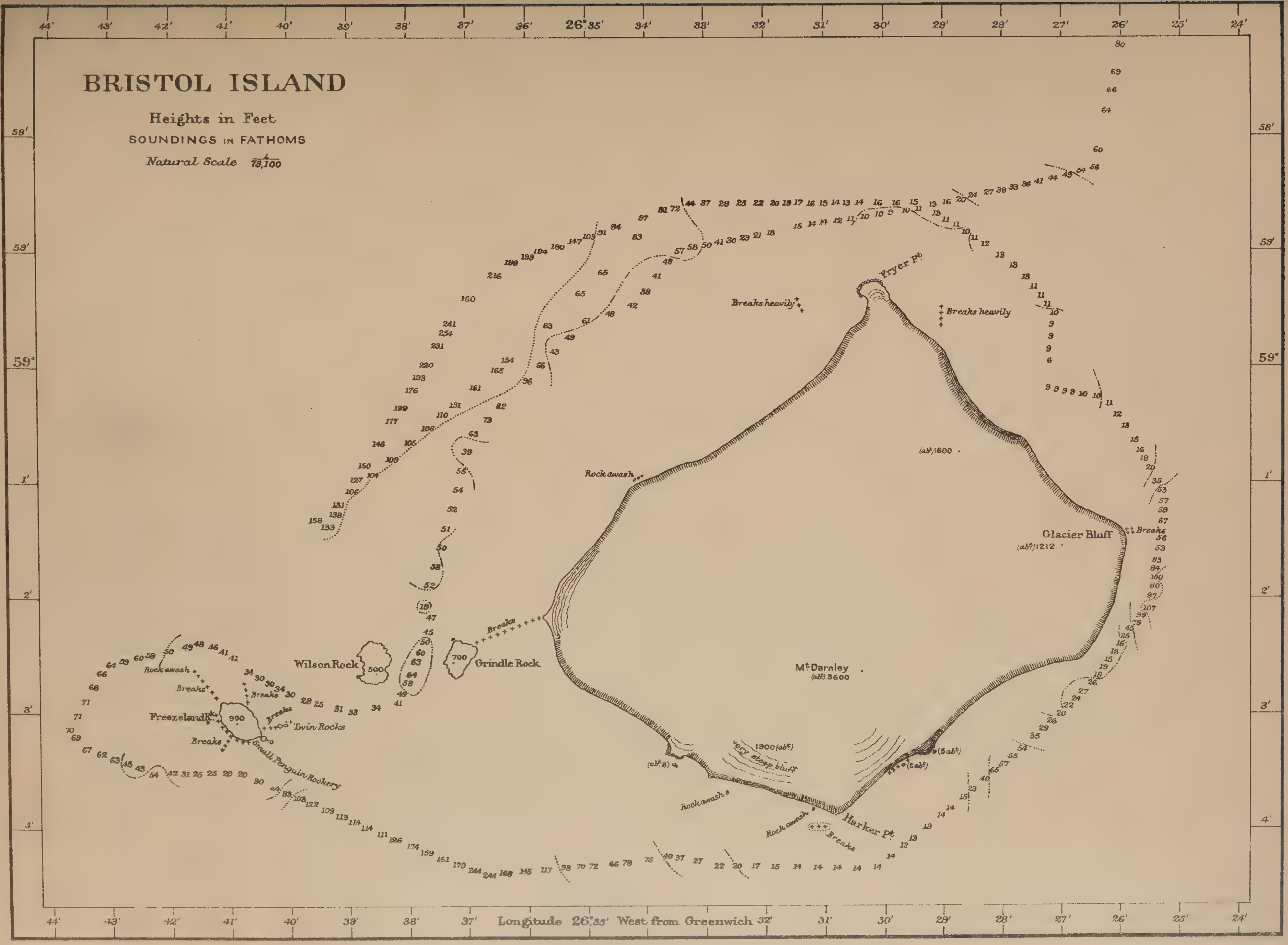

BRISTOL ISLAND
Heights in Feet
SOUNDINGS IN FATHOMS
Natural Scale 1/73,100
Fryer Pt.
Breaks heavily
Breaks heavily
Rockawash
(abt) 1600
Glacier Bluff
(abt) 1212
Breaks
Mt Darnley
(abt) 3600
(5 abt)
(5 abt)
1900 (abt)
very steep bluff
(abt 8)
Rockawash
Rockawash
Harker Pt.
Breaks
Breaks
Grindle Rock
700
Wilson Rock
500
Freezeland Rk.
900
Rockawash
Breaks
Breaks
Breaks
Breaks
Twin Rocks
Small Penguin Rookery
59°
58'
59'
1'
2'
3'
4'
44'
43'
42'
41'
40'
39'
38'
37'
36'
26° 35'
34'
33'
32'
31'
30'
29'
28'
27'
26'
25'
24'
Longitude 26° 35' West from Greenwich

PLATE XXV

Bristol Island (p. 176)

Fig. 1. The north-eastern side of the island seen from the NNW, showing heavy glaciation. Glacier Bluff is on the extreme left. The conical hill on the left is 1200 ft. high and bears 150°, distant 3½ miles.

Fig. 2. Part of the north-western side of the island. Sunlight and shade on the glacier.

Fig. 3. The whole island seen from the N by E, distant 6 miles.

Fig. 4. The outlying rocks on the western side of the island, seen from the W. On the right Freezeland Peak bearing 095°, distant 1·4 miles. To the left of the centre Wilson Rock, with the summit of Grindle Rock seen above it. On the extreme left the western point of Bristol.

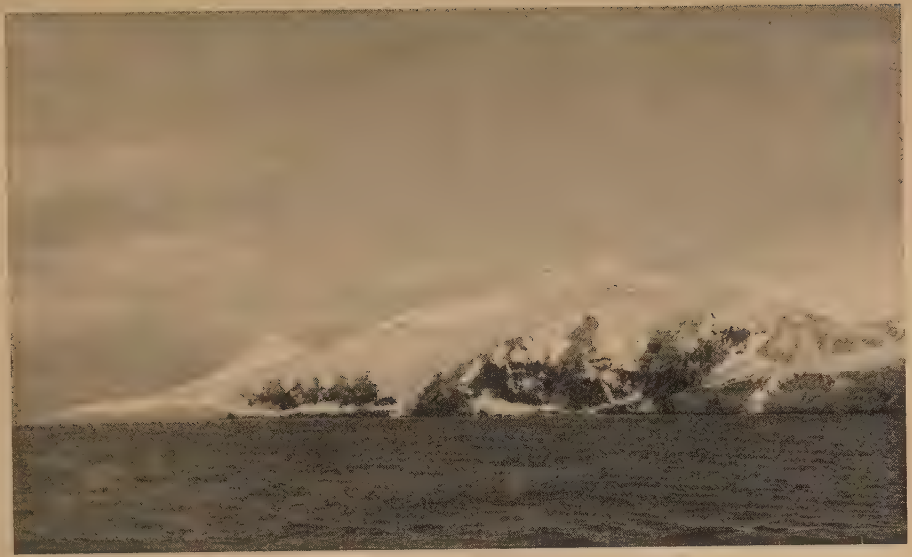


Fig. 1.

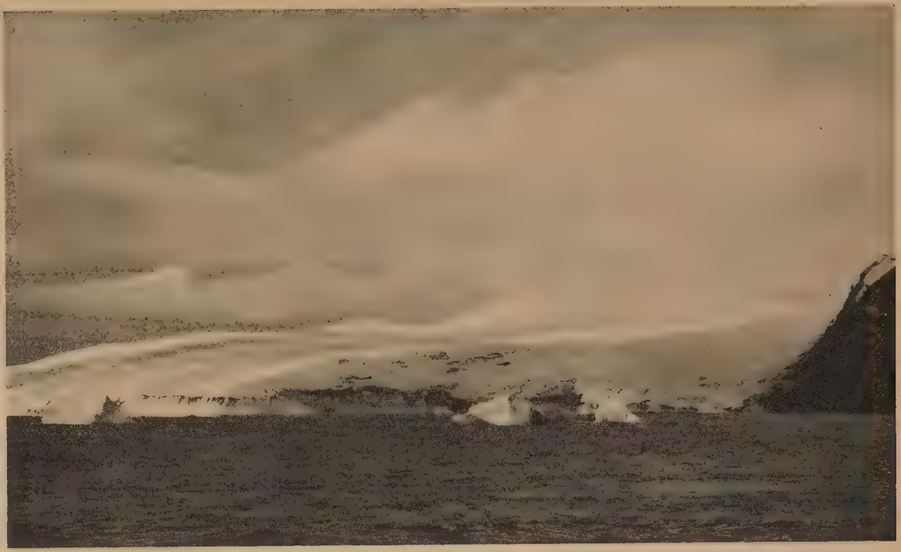


Fig. 2.

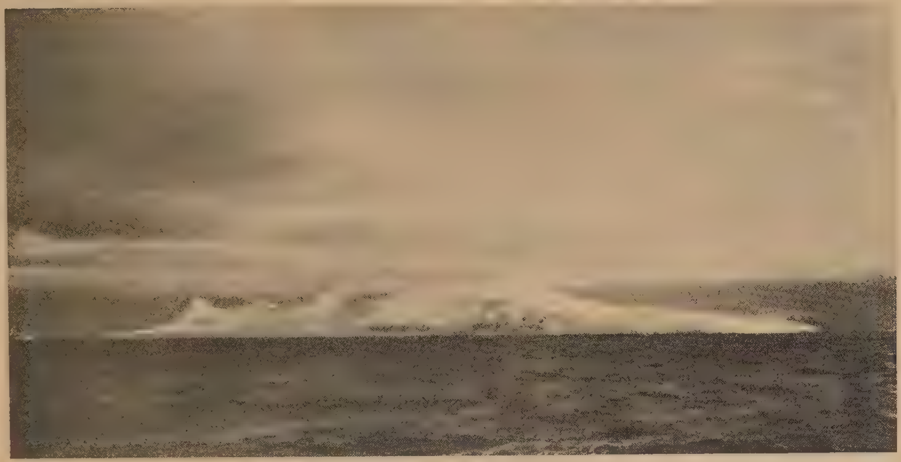
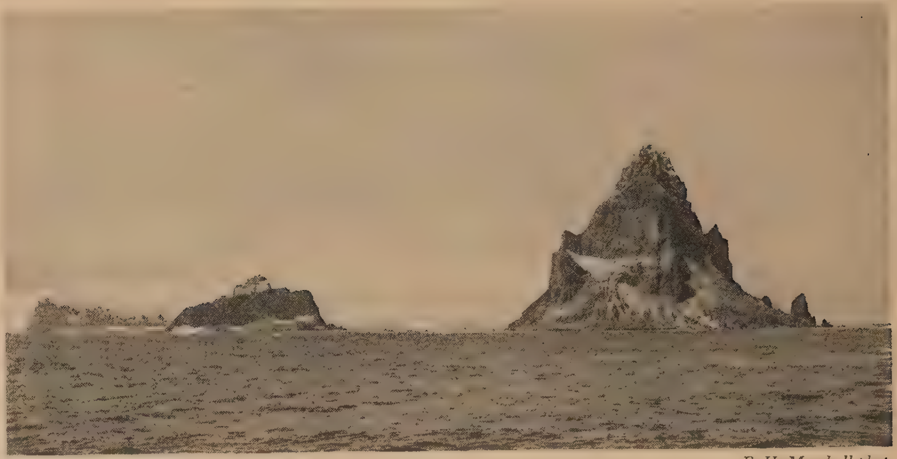


Fig. 3.



E. H. Marshall phot.

Fig. 4.

BRISTOL ISLAND

PLATE XXVI

Bristol Island (*cont.*)

Fig. 1. Freezeland Peak, the land sighted by Cook when he discovered the South Sandwich Group in 1775. The rock is seen from the N, the summit bearing 165°, distant 7 cables. The great pillar on the right, 900 ft. high, is thought to be of sedimentary rock, while the lesser peak on the left is possibly metamorphic.

Fig. 2. Another view of Freezeland Peak, seen from the SW, with the summit bearing 045°, distant 5½ cables. The slopes of talus on this rock are the resort of large numbers of penguins. Wilson Rock and part of Grindle Rock are seen in the background.

Fig. 3. Wilson Rock, 500 ft. high, seen from the SW, the summit bearing 060°, distant 5½ cables. This rock is entirely composed of black columnar basalt.

Fig. 4. Grindle Rock, 700 ft. high, seen from the W, the summit bearing 090°, distant 3 cables. The rock is mainly composed of the reddish and yellowish tuffs which are a characteristic feature of most of the islands.

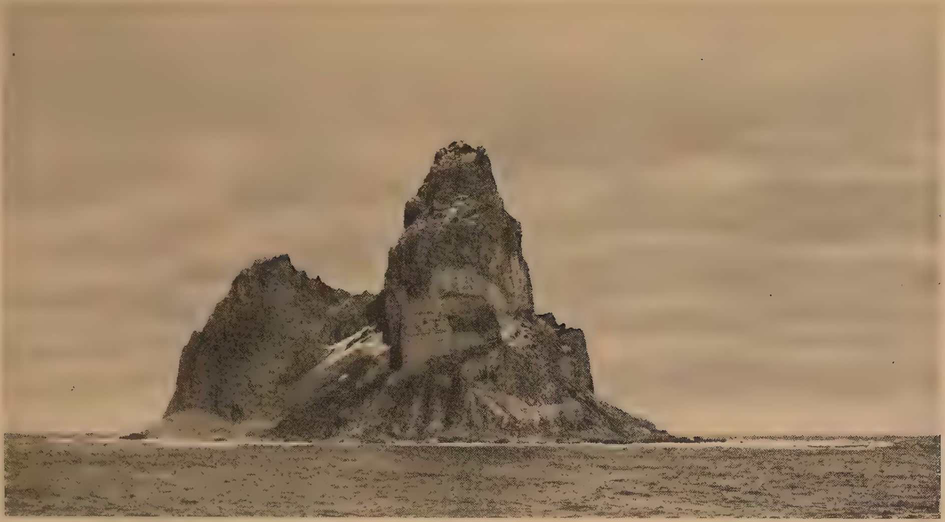


Fig. 1.

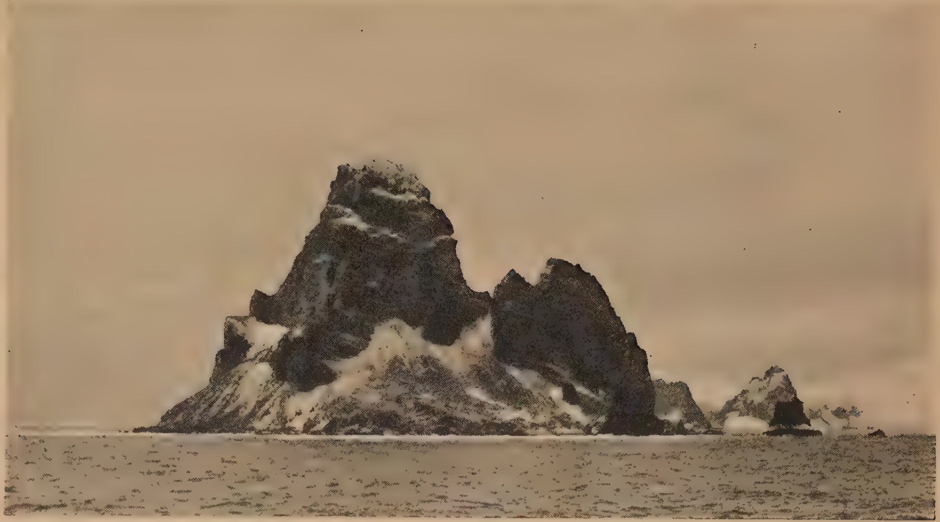


Fig. 2.

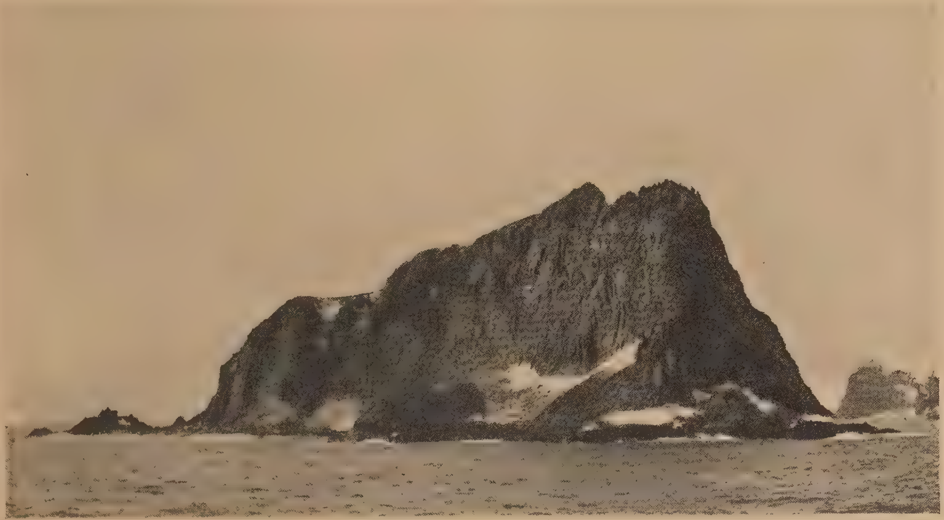
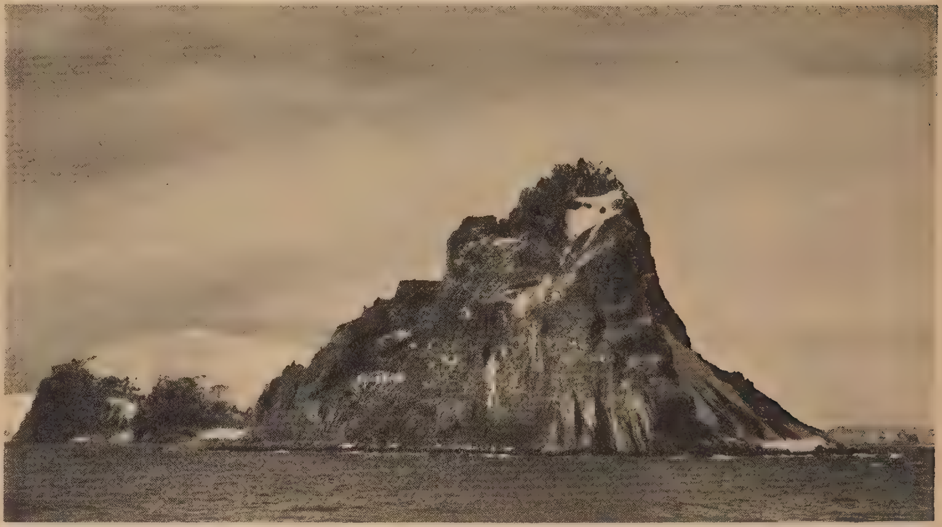


Fig. 3.



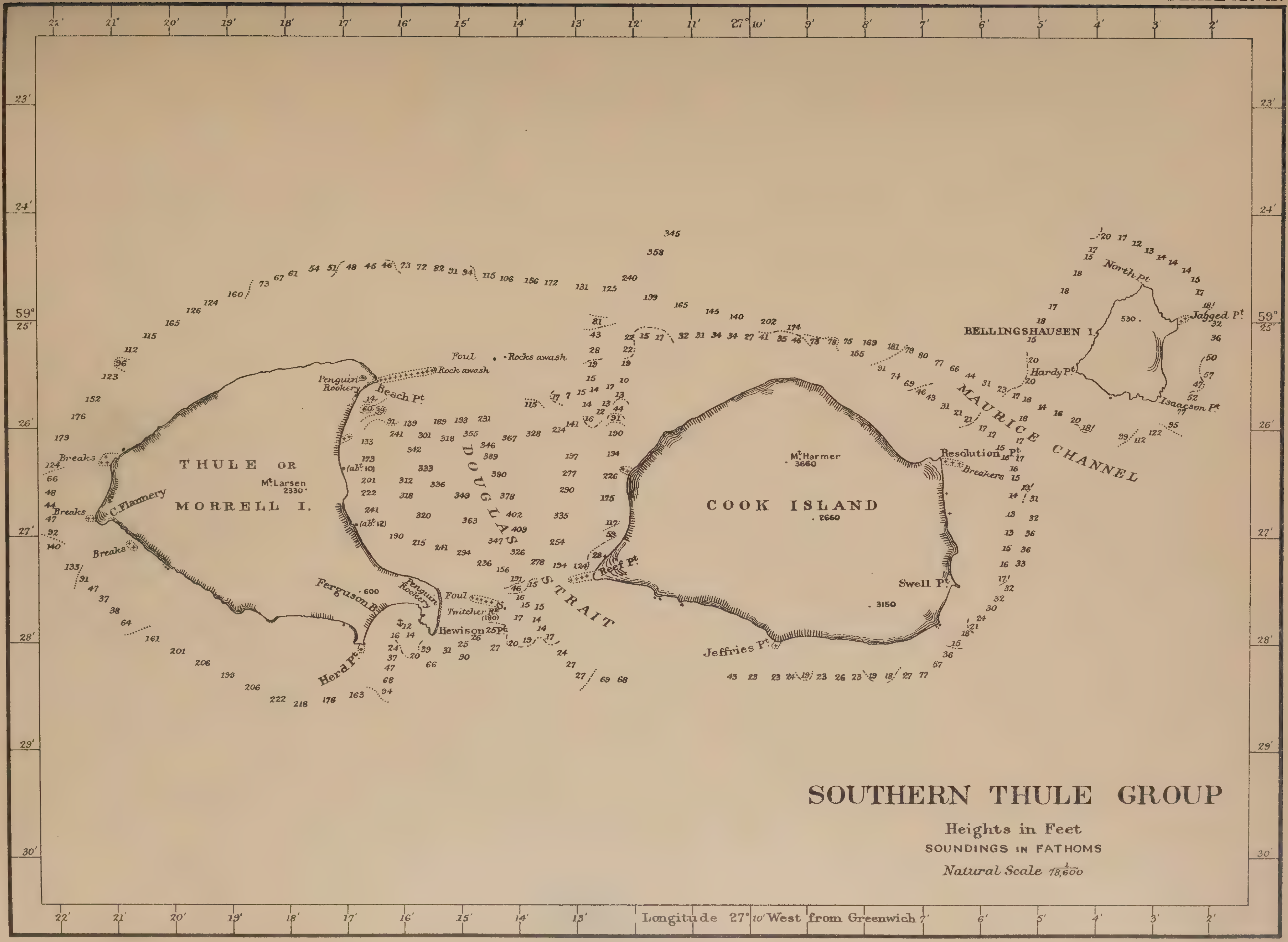
E. H. Marshall phot.

Fig. 4.

ROCKS OFF BRISTOL ISLAND

PLATE XXVII

Chart of the Southern Thule Group.



BELLINGSHAUSEN I.
North Pt.
Jagged Pt.
Isaacson Pt.
Hardy Pt.
530
MAURICE CHANNEL
Resolution Pt.
Breakers
COOK ISLAND
Mt. Harmer 3660
2660
3150
Swell Pt.
Jeffries Pt.
Reef Pt.
DOUGLAS STRAIT
Foul
Rocks awash
Rock awash
Penguin Rookery
Beach Pt.
THULE OR MORRELL I.
Mt. Larsen 2330
C. Flannery
Breaks
Ferguson B.
600
Penguin Rookery
Foul
Twitcher Rk. (180)
Hewison Pt.
Herd Pt.
(abt. 10)
(abt. 12)
Longitude 27° 10' West from Greenwich
59° 25'
27°

SOUTHERN THULE GROUP

Heights in Feet

SOUNDINGS IN FATHOMS

Natural Scale $\frac{1}{78,600}$

PLATE XXVIII

Bellingshausen Island (p. 183)

Fig. 1. View of the island from the W, the summit bearing 085°, distant 2·7 miles. North Point is on the left and Isaacson Point on the right.

Fig. 2. The island seen from the SW, the summit bearing 045°, distant 1·8 miles. The ragged brim of the large crater is visible; Hardy Point is on the left and Isaacson Point on the right.

Fig. 3. A nearer view of part of the island, the summit bearing 010°, distant 1·1 miles. The brim of the crater is visible in almost all its extent. Note the thin covering of snow and the large tracts of bare ground.

Fig. 4. Part of the island seen from the SE, Jagged Point on the right bearing 000°, distant 9 cables. This view shows the steep cliffs on the eastern side which fall almost vertically from the crater's edge to the sea.

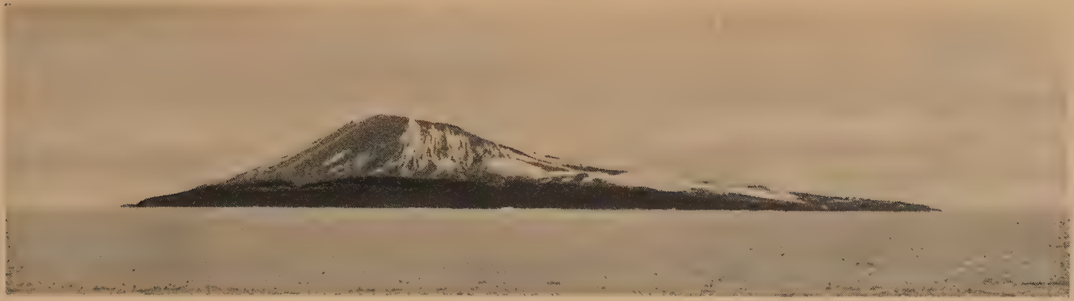


Fig. 1.

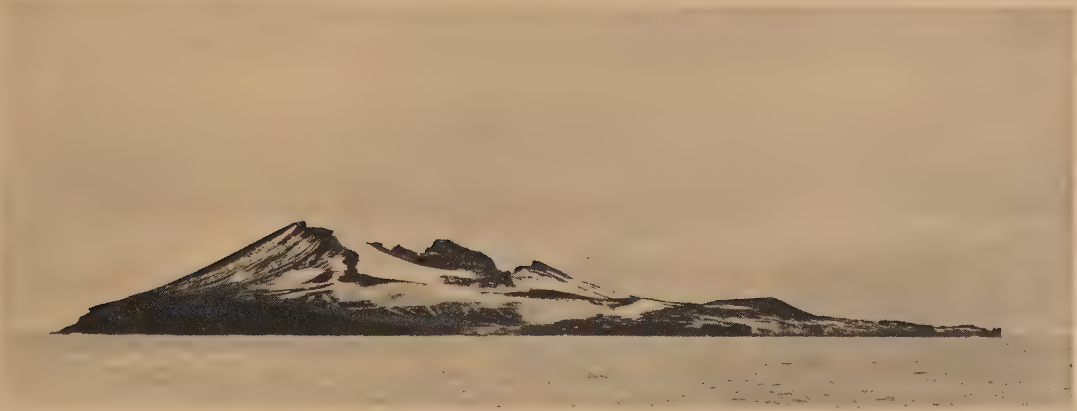


Fig. 2.

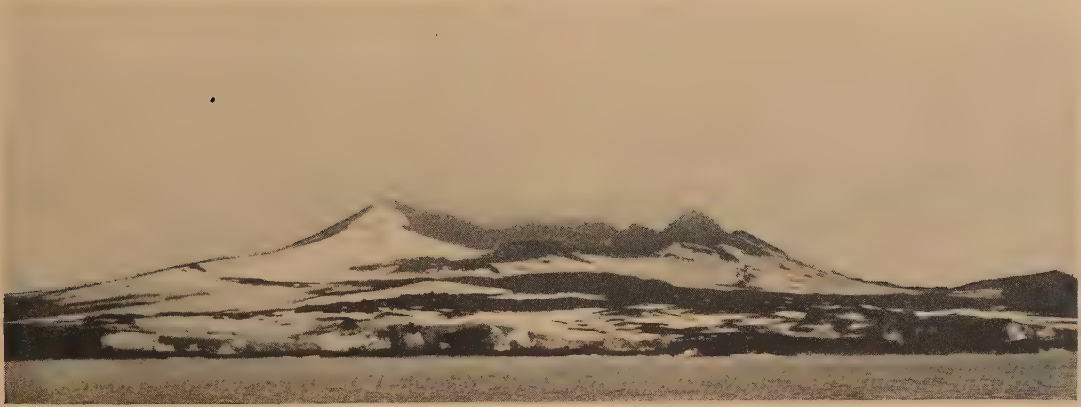
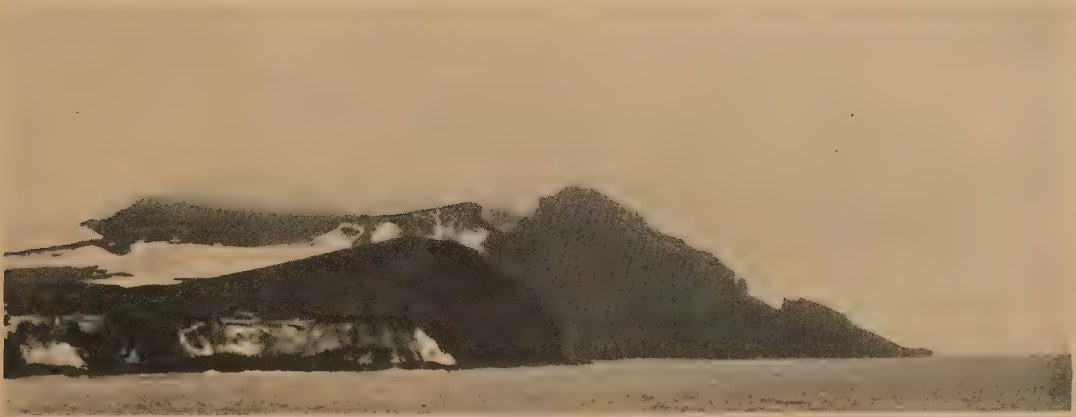


Fig. 3.



E. H. Marshall & A. J. Clowes phot.

Fig. 4.

BELLINGSHAUSEN ISLAND

PLATE XXIX

Cook Island (p. 185)

Fig. 1. The south side of the island seen from the W, showing extensive glaciation. Jeffries Point in the centre bears 080°, distant 1·9 miles.

Fig. 2. Part of the glacier to the E of Jeffries Point seen from the S at a distance of 3½ cables.

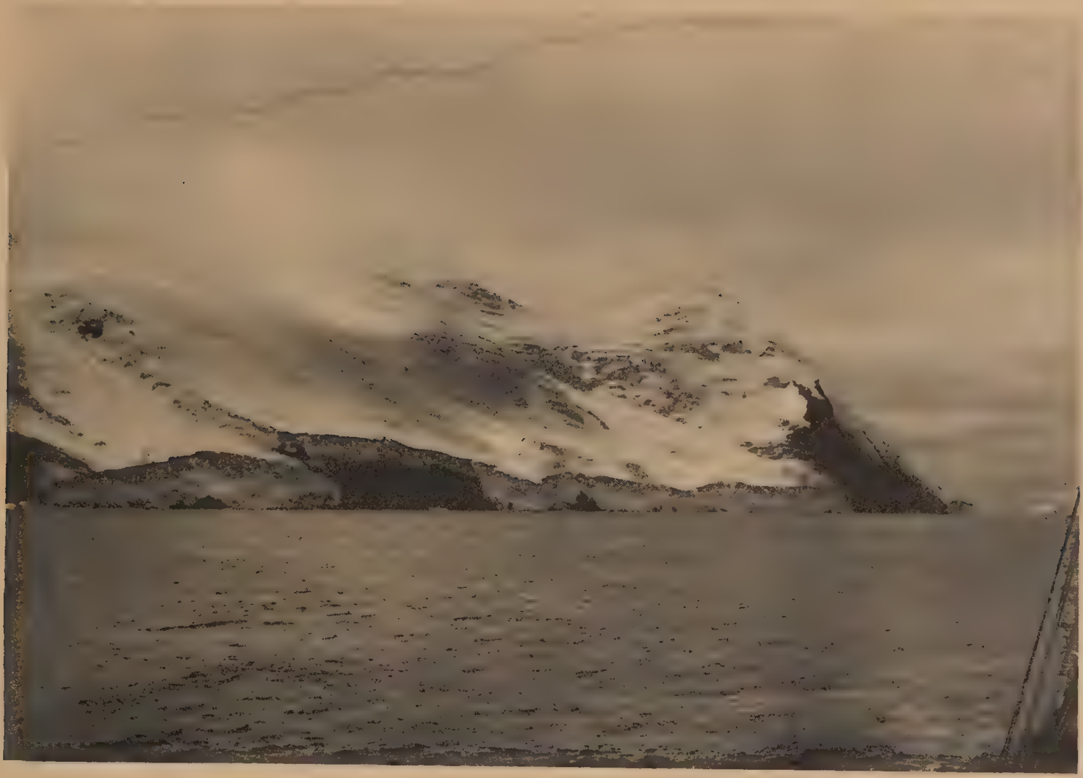


Fig. 1.

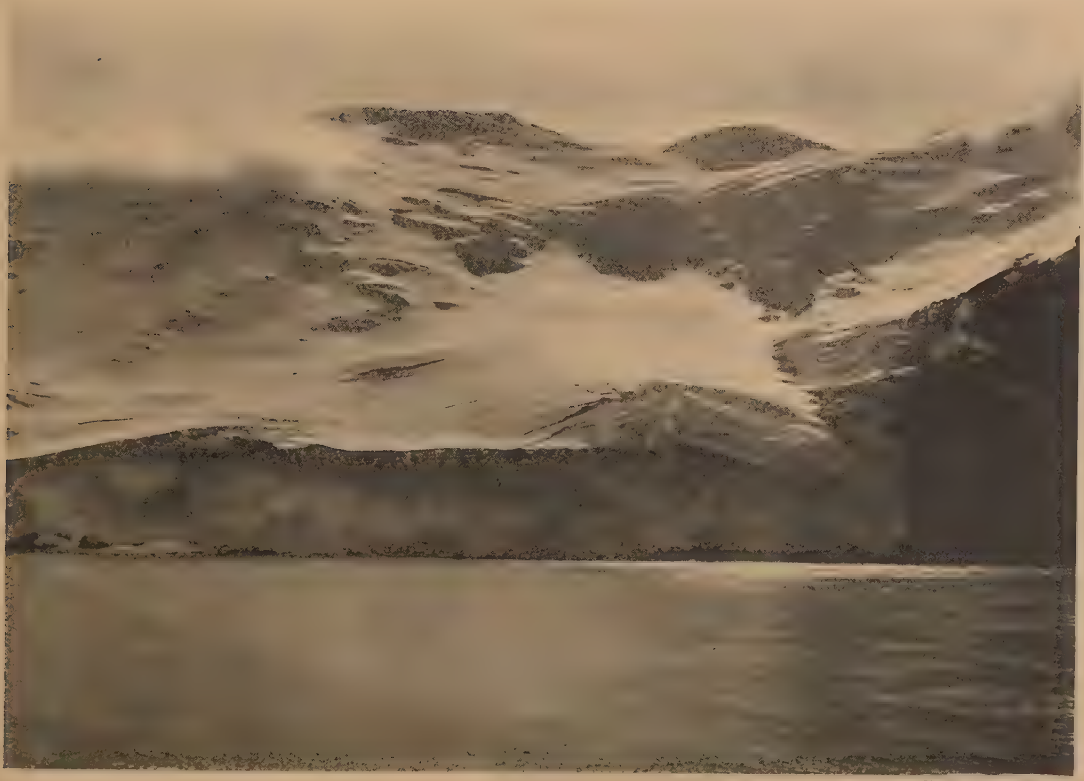


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Fig. 2.

COOK ISLAND

PLATE XXX

Cook Island (*cont.*)

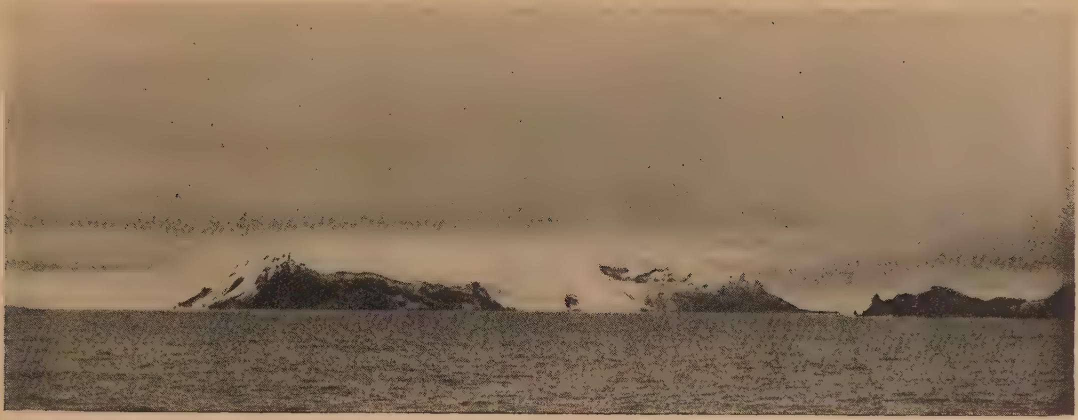
Fig. 1. The island seen from the NW, its summit hidden in cloud. Maurice Channel is on the left, and on the right, separated by Douglas Strait, is Beach Point, Thule Island.

Thule Island (p. 187)

Fig. 2. The island, with its summit hidden in cloud, is seen from the NE. On the left is part of Cook Island and the low black ridge of Beach Point is seen on the right.

Fig. 3. Beach Point, where a landing was effected, seen from Douglas Strait. The point bears 000°, distant 1½ cables.

Fig. 4. The eastern side of the island, facing Douglas Strait, viewed from the N. Beach Point in the foreground, bearing 180°, distant 1·6 miles.



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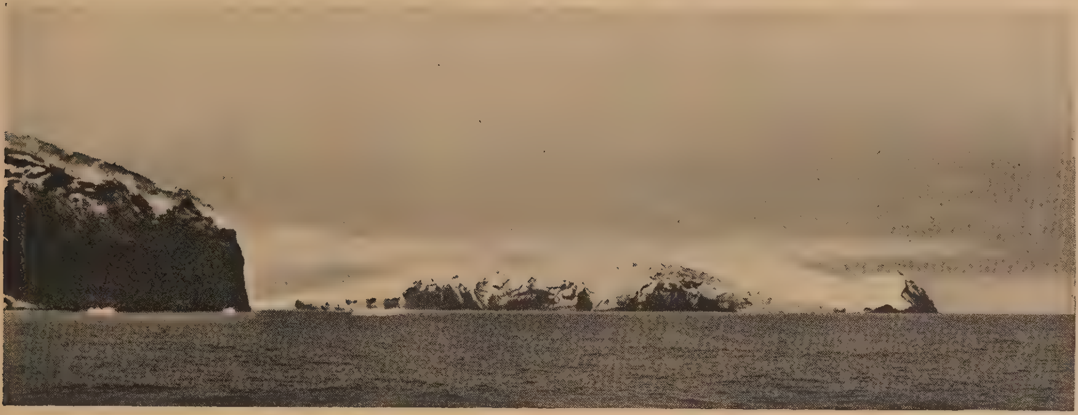

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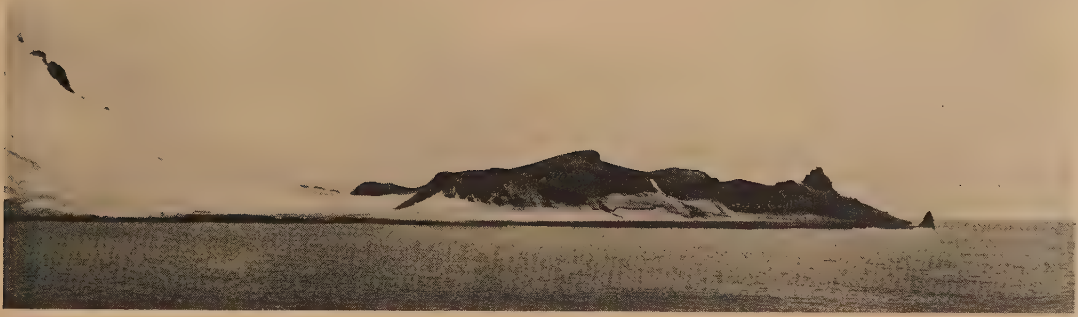

Fig. 3.

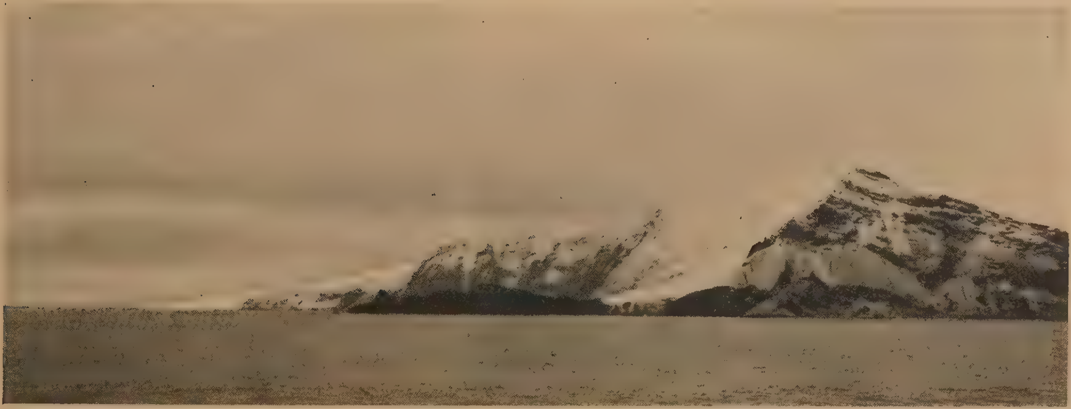

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Fig. 4.

COOK AND THULE ISLANDS

PLATE XXXI

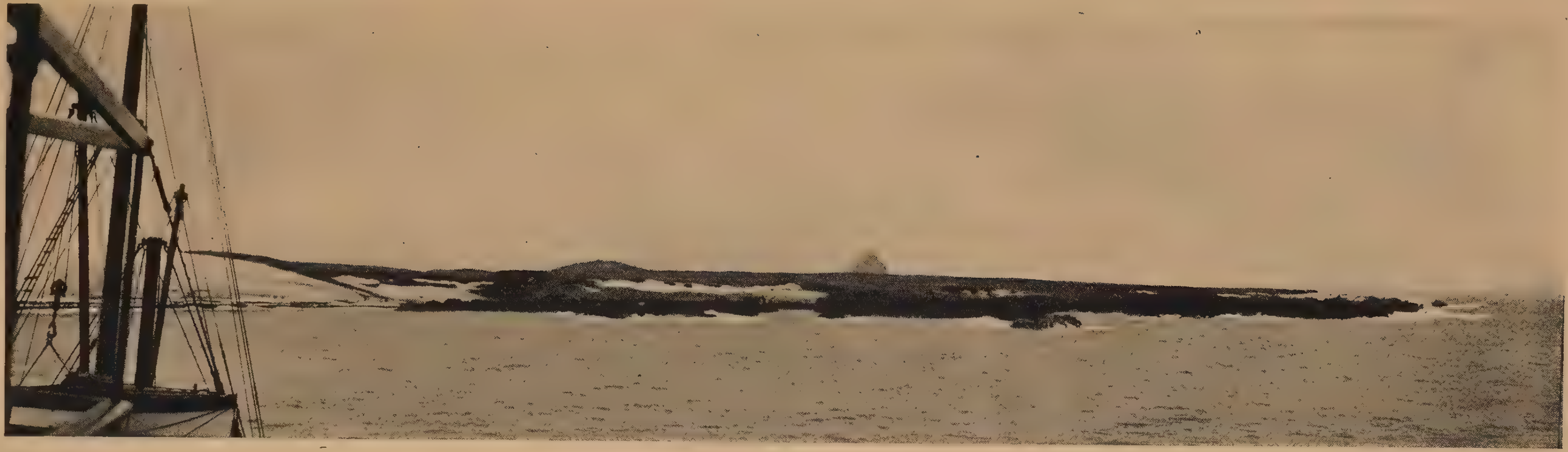
Thule Island (*cont.*)

Fig. 1. View looking E in Ferguson Bay, the best anchorage in the South Sandwich Islands. The basalt plateau ends on the right in Hewison Point, which bears 125°, distant 2½ cables. Twitcher Rock is seen in the background.

Fig. 2. Glacier face in Ferguson Bay, taken at a distance of 1 cable, showing silt bands in the ice.

Fig. 3. Twitcher Rock, 180 ft. high, seen from the NE, bearing 235°, distant 2 cables. Hewison Point is concealed behind the rock.

Fig. 4. Another view of Twitcher Rock, taken from the SE and bearing 310°, distant 4½ cables.



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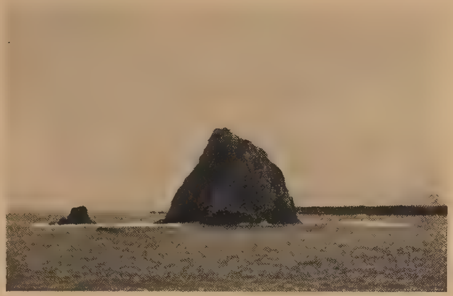

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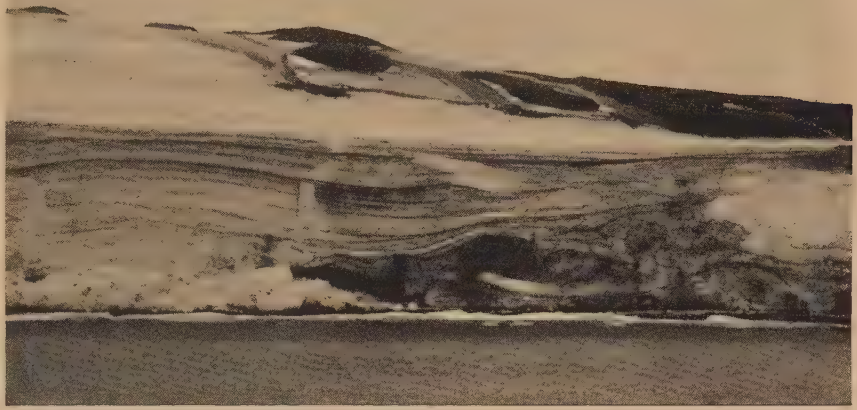


Fig. 2.

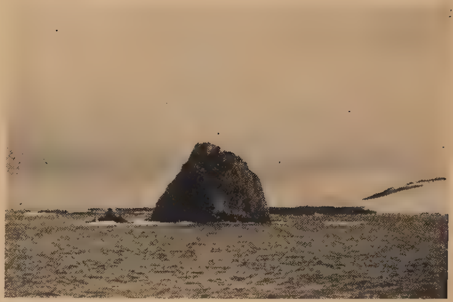
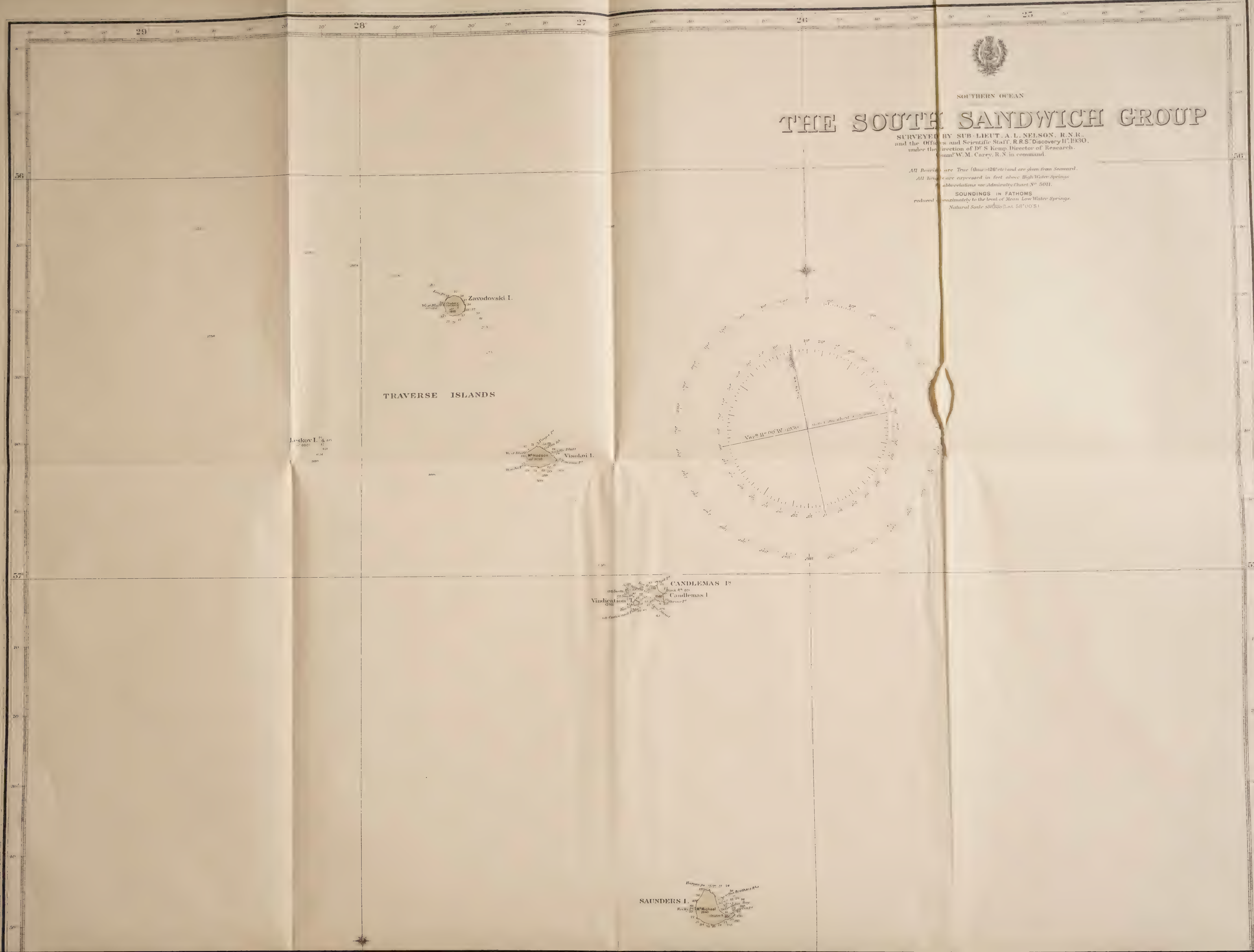


Fig. 4.

E. H. Marshall phot.

THULE ISLAND


SOUTHERN OCEAN

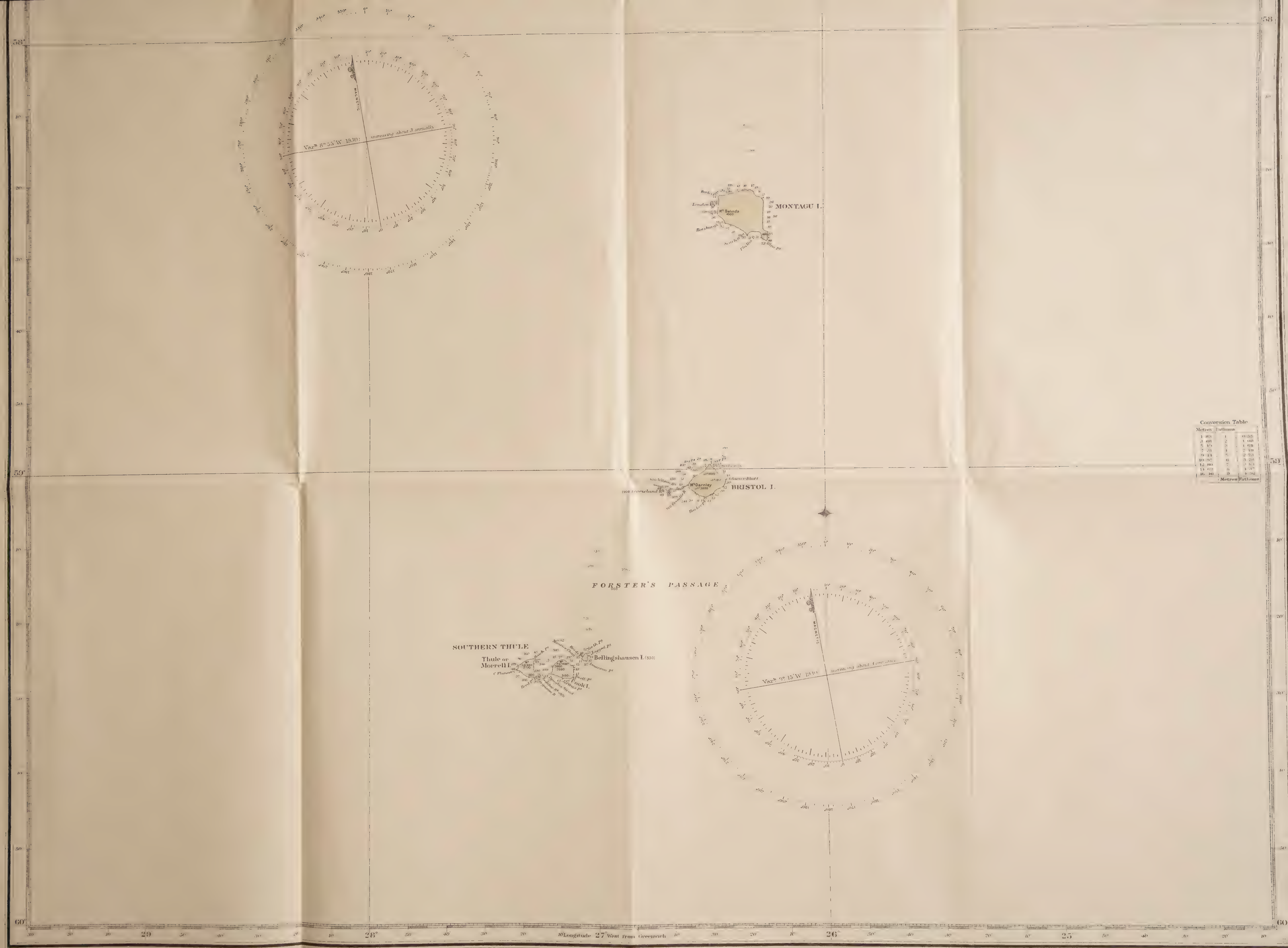
THE SOUTH SANDWICH GROUP

SURVEYED BY SUB-LIEUT. A. L. NELSON, R.N.R.,
and the Officers and Scientific Staff, R.R.S. "Discovery II", 1930,
under the direction of Dr S Kemp, Director of Research.
Commr W. M. Carey, R.N. in command.

All Bearings are True (thus:-126° etc) and are given from Seaward.
All heights are expressed in feet above High Water Springs
For abbreviations see Admiralty Chart No 5011.

SOUNDINGS IN FATHOMS
reduced approximately to the level of Mean Low Water Springs.
Natural Scale $\frac{1}{500,000}$ (Lat. 58°00'S)

29
28°
27
26
25
56°
57°
Zavodovski I.
TRAVERSE ISLANDS
Leskov I.
Visokoi I.
Mt Hodson
CANDLEMAS Is
Candlemas I.
Vindication I.
SAUNDERS I.
Mt Michael
Varn 11° 00' W 1930


MONTAGU I.
Mt Belinda
4500
Borley Pt
London Rk
Borsburgh Pt
Scarlett Pt
Phillips Pt
Allen Pt
BRISTOL I.
Mt Darnley
abt 3600
abt 1600
Glacier Bluff
500 Wilson Rk
1900 Freezeland Rk
700 Grindle R
Harker Pt
FORSTER'S PASSAGE
SOUTHERN THULE
Thule or
Morrell I.
Mt Larsen
2130
Mt Harmer
3660
Cook I.
Bellingshausen I. (530)
Beach Pt
Maurice Chan
North Pt
Jagged Pt
Isaacson Pt
Swell Pt
Jeffries Pt
Douglas Strait
Ferguson B
C. Flannery
Herd Pt
Varn 8° 55' W 1930 increasing about 3' annually
Varn 9° 15' W 1930 increasing about 3' annually
MAGNETIC
58°
59°
60°
29
28°
Longitude 27° West from Greenwich
26°
25
Conversion Table

Conversion Table

Metres	Fathoms	
1 83	1	0 55
3 66	2	1 09
5 49	3	1 64
7 31	4	2 19
9 14	5	2 73
10 97	6	3 28
12 80	7	3 83
14 63	8	4 37
16 46	9	4 92
	Metres	Fathoms

London. Published at the Admiralty, 22nd Novr 1930 under the Superintendence of Rear Admiral H.P. Douglas C.B. C.M.G. Hydrographer

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PRESS

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NEBALIACEA

By

H GRAHAM CANNON, Sc.D.
Professor of Zoology, University of Manchester

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NEBALIACEA

By H. Graham Cannon, Sc.D.
Professor of Zoology, University of Manchester

(Plate XXXII, text-figs. 1–7)

This report deals with the Nebaliacea collected by the 'Discovery' during the years 1925–7.

Nebaliopsis typica, G. O. Sars

Nebaliopsis typica was originally described by Sars (1887) from a damaged specimen and a fragment collected by the Challenger Expedition. Thiele (1904) subsequently described the limbs in detail from a crushed specimen collected by the Valdivia Deep Sea Expedition. The Swedish Antarctic Expedition was the first to obtain, in 1902, a complete and undamaged specimen. This was briefly described and figured in a posthumous note by Ohlin (1904), from which it appears that the animal was still alive when it reached the surface. Ohlin merely named the specimen "a new Nebalia", but there is no doubt that it belonged to the genus *Nebaliopsis*. Unfortunately, however, it has been lost. Dr Nils Odhner of the Riksmuseum, Stockholm, in a letter to me says: "It is very likely that it followed the sinking 'Antarctic' to the bottom, when it was wrecked". The Discovery Expedition collected seven specimens during 1925–7, of which six were crushed or fragmentary, but one was complete and undistorted. Enlarged photographs of this specimen are shown in Plate XXXII.

The following list gives details of all the specimens of *Nebaliopsis* which have been found up to the present:

Table I.

Expedition	Locality		Depth	Total length (mm.)	Carapace length (mm.)	Ratio
	Lat.	Long.				
Challenger						
*A**	46° 46′ S	45° 31′ E	1375 fathoms	—	29	—
B†	39° 41′ S	131° 23′ W	2550 fathoms	22 (+3)	16	1·56
Valdivia	0° 20·2′ N	6° 45′ W	3500 m. vertical net	35	22	1·59
Swedish Antarctic‡	48° 27′ S	42° 36′ W	2500 m. vertical net	20	14·5	1·38
Discovery 1925–7						
A. St. 81	32° 45′ S	8° 47′ W	650 (–0) m.	19·5	16	1·22
B. St. 72*	41° 43′ 20″ S	42° 20′ 40″ W	2000 (–0) m.	—	19·5	—
C. St. 101	33° 50′ S	16° 04′ E	2480–2580 m.	30	18	1·67
D. St. 78§	35° 18′ S	19° 01′ 10″ W	1000 (–0) m.	14	8 (approx.)	1·75
E. St. 256§	35° 14′ S	6° 49′ E	850–1100 (–0) m.	13	—	—
F_1. St. 89§	34° 05′ 15″ S	16° 00′ 45″ E	1000 (–0) m.	14	—	—
F_2. St. 89¶	34° 05′ 15″ S	16° 00′ 45″ E	1000 (–0) m.	25	15	1·67

* Carapace and front part of body only.
† Caudal rami missing.
‡ Living when brought to surface—subsequently lost.
§ Immature. Carapace crushed.
¶ Complete undamaged specimen (Plate XXXII).

It has been assumed from the fact that *Nebaliopsis* has only been obtained from deep hauls that it lives at great depths. However, specimen *C* from St. 101 is the first example which has been collected at a known depth. All other specimens were collected by nets which were open on their way up to the surface. Specimen *C* was collected at a depth of approximately $1\frac{1}{2}$ miles.

With regard to localities, the Valdivia specimen is the only representative from tropical waters, the remainder having been collected from sub-tropical to antarctic localities. Of the Challenger specimens, one was collected in the south-west Indian Ocean and the other in the South Pacific. The remainder are all Atlantic specimens.

There is a peculiar mistake in the map published by Thiele (1905, p. 67) in which he records *Nebaliopsis* as having been collected from a point south of Australia. This is presumably the second Challenger specimen from St. 289 in which the longitude has been plotted E instead of W.

From the measurements quoted in Table I, it will be seen that there is considerable variation in the length of the carapace. This is partly only apparent and results from the difficulty of accurate measurement owing to the distortion of most of the specimens, but that there is a real variation can be seen by comparing the ratios taken from Ohlin's figure and that from specimen F_2, both of which were undamaged.

There is similarly a marked variation in the structure, but not the size, of the anterior limbs. Thiele gave a very complete description of the setation and detailed anatomy of the limbs of his specimen. I have compared the antennules, antennae and mandibles of five of the Discovery specimens with Thiele's description and, while I found a general agreement, there was a very marked variation. It would serve no purpose to record the setation of each limb of the Discovery specimens, but there are several general conclusions which can be stated from the comparison.

The larger specimens are markedly more setose than the smaller. This is seen clearly in the mandibular palp. In specimen *A* (total length 19·5 mm.) the middle joint carries two setae on its median face and the distal joint a row of fifteen, while specimen *C* (total length 30 mm.) bears an irregular row of ten setae on the middle joint and a row of twenty on the distal. A more marked difference is seen by comparing specimen *C* with *D*, but from other characters it is clear that specimen *D* is immature.

The fourth joint of the antennule is produced on its median face into a long pointed process (Thiele, 1904, Pl. 3, fig. 41), which carries a row of marked teeth on its anterior edge. These teeth become obliterated in the larger specimens.

The scale of the antennule, which, according to Thiele, carries a curved row of about fifteen setae, becomes more setose in the larger specimens and loses its characteristic shape (Thiele, 1904, Pl. 3, fig. 40). Thus, in specimen *D*, the scale carries a curved row of seven setae and terminates in a triangular point. In specimen *B* it carries fifteen setae and is an ovoid plate.

Specimens *D*, *E* and F_1 are undoubtedly larval specimens. The flagellum of the antennule is in each case six- instead of twelve-jointed. The most marked difference is in the pleopods. In each case the fourth pleopods consist of a pair of minute knobs, while the fifth and sixth pairs are fully developed proportionately to the first, second and third pairs. Claus (1889, p. 34, Pl. 1, fig. 3) has recorded an identical condition in *Nebalia geoffroyi*.

Thiele (1904, p. 24) has suggested that his specimen should be distinguished from the typical form as a variety *atlantica*, on the grounds that its rostrum showed a slightly different shape and the exopodites of its pleopods were narrower than those figured by Sars.

I have examined the original specimen from which Sars drew his figures and cannot see any appreciable difference between its rostrum and that figured by Thiele (1904, Pl. 3, fig. 38). In addition, I find that Sars' figure of the third pair of pleopods (1887, Pl. 3, fig. 4) is inaccurate. In his figure the ratio of length to breadth of the exopodite is only 2·3:1, while from actual measurement I found it to be 3·2:1. The form of the pleopods agreed closely with both Thiele's figures and with the Discovery specimens. I consider therefore that there is no evidence to justify the establishment of a new variety for the Valdivia specimen.

With regard to the incomplete Challenger specimen (first on the list, p. 201) it is possible that this may represent a distinct species. The complete animal must have been very large—about half as long again as any other specimen yet found. The carapace is more distinctly corrugated than the normal and is of a pale yellow-brown colour. These characters, however, may well be signs of age, and on them alone it would be unjustifiable to establish a new species or variety.

By studying the undistorted specimen F_2, I have been able to make out the normal arrangement of the limbs and so to deduce something as to the mode of life of *Nebaliopsis*.

The specimen, as I received it, was extremely transparent. Ohlin's living specimen was described (Ohlin, p. 59) as "in Leben ganz durchsichtig, glashell....Das einzige, was man von ihm...sehen konnte, waren die zwei rotgelblich schimmernden, überaus kleinen Augen". This transparency made it very difficult to study. Whatever illumination was used, the light penetrated the tissues so that individual parts were very difficult to distinguish. In addition, in the centre of the body, there was an opaque orange ovoid mass which obscured everything above and below it. I have not been able to settle the exact nature of this mass. It was probably the remains of the ovary. Eventually I found that by focussing a point source (a 150 C.P. Pointolite) on the edge of the limb I was studying, I was able to light up that part leaving the rest of the animal more or less in the dark. This, for instance, was the only way I could see the edge of the carapace. However, I did not make any real headway until I had the beautiful photographs (Plate XXXII) which I owe entirely to the skill of my colleague, Prof. C. J. Patten. These were taken originally at a magnification of about 1·5, the specimen lying in spirit on a piece of black velvet. The illumination was ordinary north daylight on a fairly dull day. By this method the surface only of the animal has been photographed, as will be seen from the side view where the opaque mass in the centre of the body is practically invisible. Without these photographs I could not have spoken with any certainty as to the limb arrangement. Figs. 1 and 2 are detailed drawings based on the lateral and ventral photographs.

After as complete a study of the whole specimen as I could make, I embedded it in paraffin wax and sectioned it parasagittally down to the middle plane. The remaining half was dissolved out of the wax by xylol and transferred back to spirit. In this way I have obtained a series of sections from which it will be possible to study, to a certain extent, the internal anatomy. But, more important, in the remaining whole half, I was able to view the limbs from the median aspect, and without this view I maintain that in most Crustacea it would be useless to speculate as to the method of functioning of the limbs. I have not drawn a figure of this view as the overlapping of the setae would have obscured the essential details. In Fig. 4 I have drawn a series of figures showing separately the median aspects of the mouth parts, the first, second and part of the third trunk limbs. This series can be compared with the corresponding figures of *Nebalia* which I have already published (1927, p. 361, Text-fig. 4).

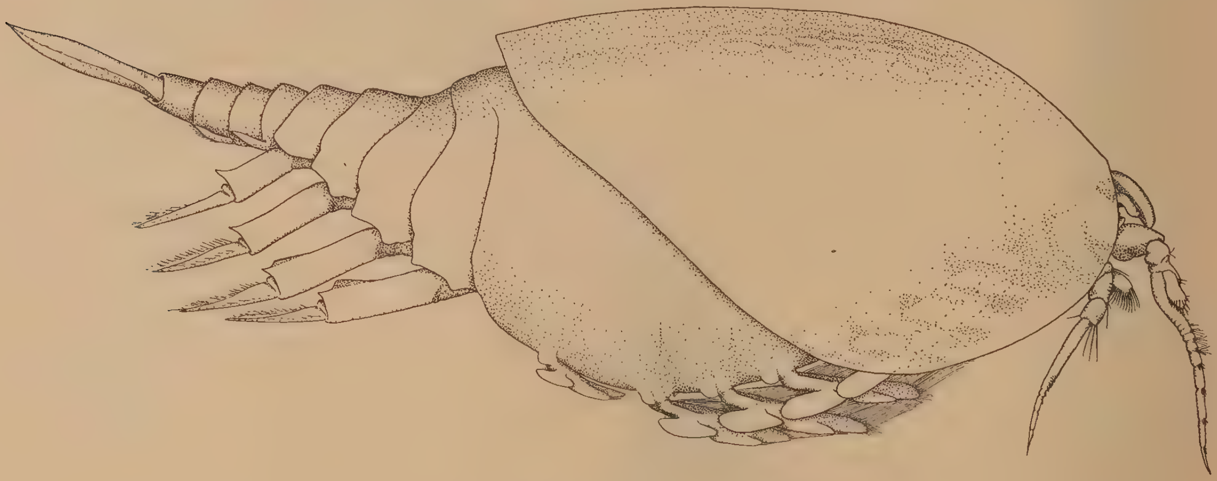

Fig. 1. *Nebaliopsis typica.* Side view.

The antennules, antennae and mandibles have been described in sufficient detail by Thiele (1904) and I have nothing further to add beyond what I have already described.

The maxillule, as Thiele states (1904, p. 21), is two-jointed, the palp being reduced to a small stump. This is not, however, blunt as in Thiele's figure (Pl. 3, fig. 48) but terminates in a feathered spine about as long as the palp itself (Fig. 3). The arrangement of the two endites shows a similarity to that of other Malacostraca but has been distorted by the flattening out of the region immediately behind the mouth. In *Nebalia* the lower lip is deeply cleft into two marked paragnaths. The setae of the proximal endite curve round behind the latter and point directly into the mouth as in all the primitive Malacostracan groups. The setae of the distal endites bite together in the middle line immediately underneath the paragnaths (Cannon, 1927, p. 364, Text-fig. 7). In *Nebaliopsis* the paragnaths have become flattened out into two indistinct ridges running parallel to the median plane, and, in so doing, appear to have pushed the maxillules

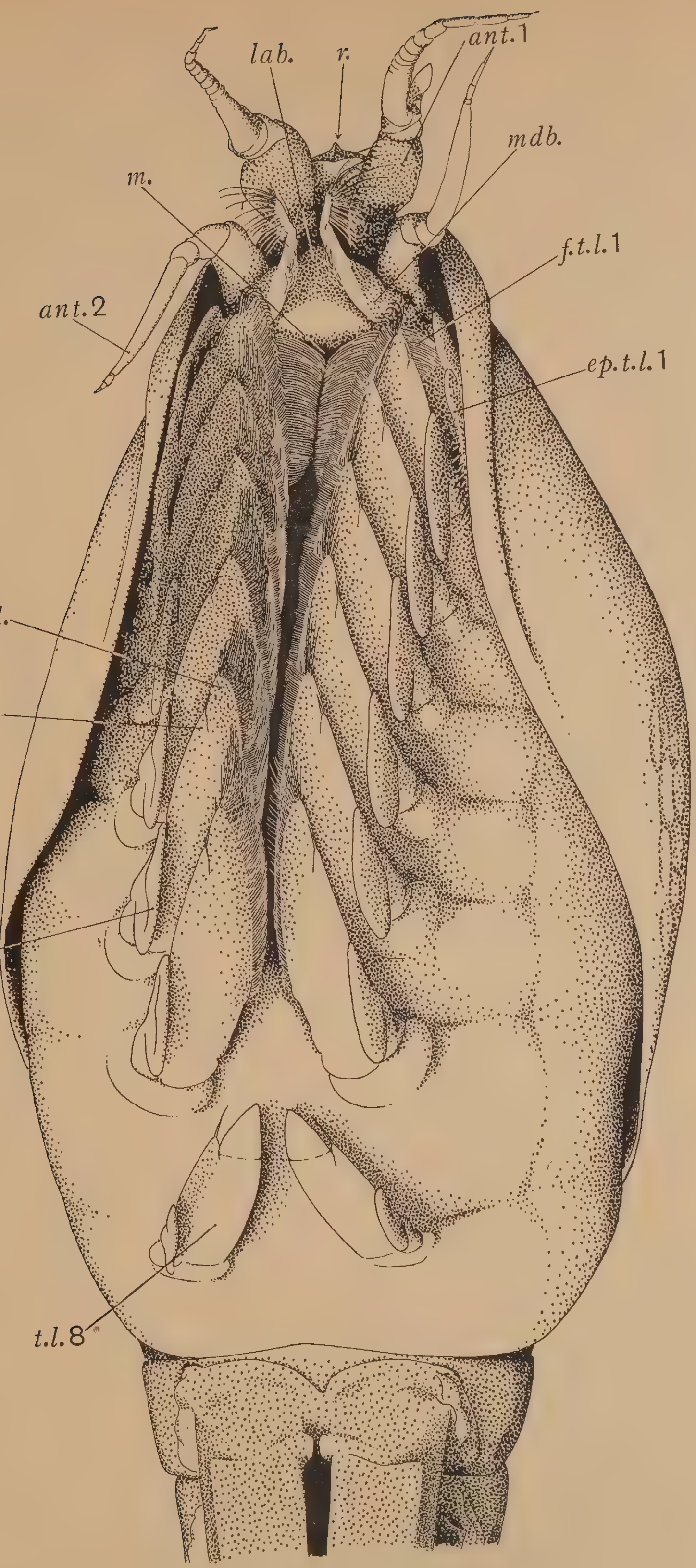
lab.
r.
ant.1
mdb.
m.
f.t.l.1
ant.2
ep.t.l.1
end.
ex.
ep.
t.l.8

Fig. 2. *Nebaliopsis typica*. Ventral view.

ant. 1, antennule; *ant.* 2, antenna; *end.* endopodite; *ep.* epipodite; *ep.t.l.* 1, epipodite of first trunk limb; *ex.* exopodite; *f.t.l.* 1, filter setae of first trunk limb; *lab.* labrum; *m.* mouth; *mdb.* mandible; *r.* rostrum; *t.l.* 8, eighth trunk limb.

laterally. The three setae borne by the proximal endite of the maxillule still point towards the mouth, but they lie close against the anterior limit of the paragnaths. The distal endites extend forwards on either side of the labrum, the posterior setae recurving towards the mouth (Fig. 4 A).

The maxilla is, in some respects, reduced. Thus the endopodite consists of a small distal lobe while the exopodite is either absent or represented by a group of three or four lateral setae. There are four endites of which the second, third and fourth form a small group of three setose lobes at the base of the endopodite. Despite this simplification in structure the maxilla is relatively enormous compared with that of *Nebalia*, and this is due to the development of the first endite, which is approximately twice the length of the rest of the limb. It consists of a curved spoon-shaped plate armed on the inner edge with a row of closely set setae (Fig. 4 A). In *Nebalia* I pointed out (1927, p. 365) that the most anterior setae on this endite curve round the hinder face of the paragnaths just as do the setae of the proximal endite of the maxillule, and, since the limb projects at right angles to the body axis, the tips of these setae lie in one transverse plane. In *Nebaliopsis* the homologous setae occupy a similar position but, owing to the

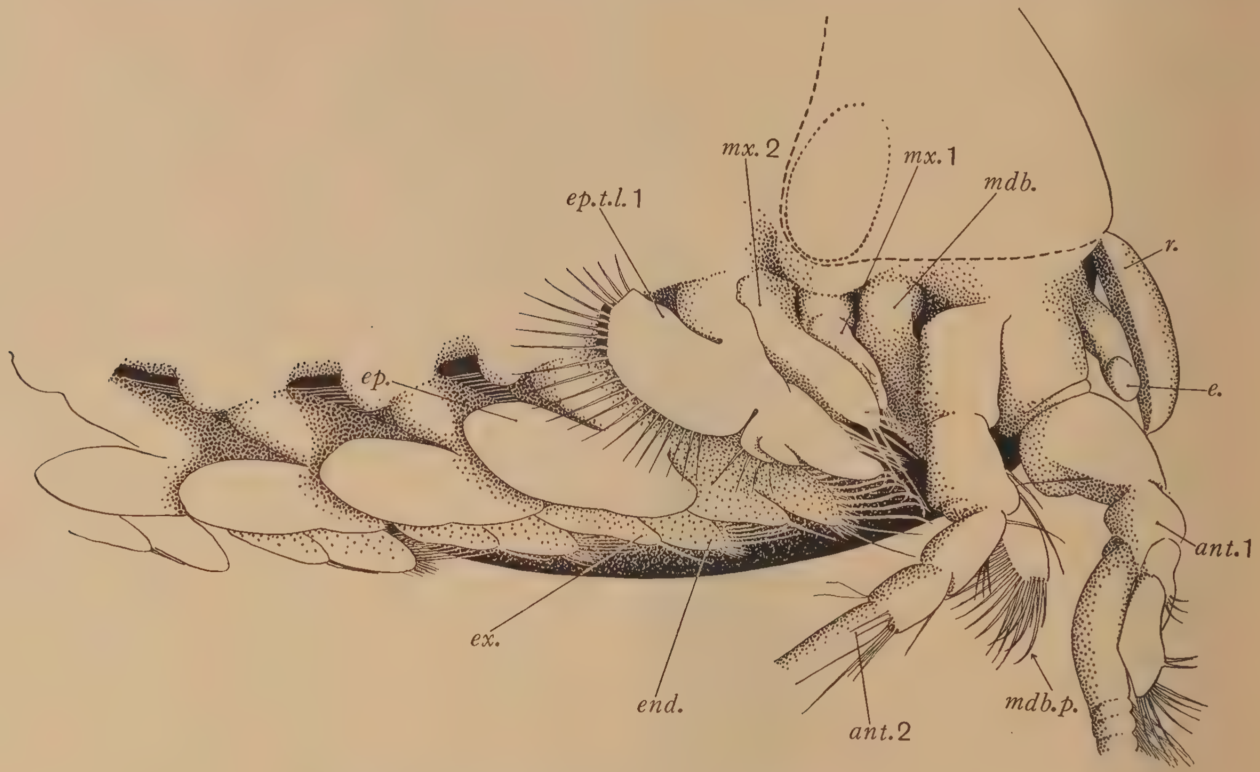

Fig. 3. *Nebaliopsis typica*. Lateral view of front part of body after cutting away the right half of the carapace.

ant. 1, antennule; *ant.* 2, antenna; *e.* eye; *end.* endopodite; *ep.* epipodite; *ep.t.l.* 1, epipodite of first trunk limb; *ex.* exopodite; *mdb.* mandible; *mdb.p.* mandibular palp; *mx.* 1, maxillule; *mx.* 2, maxilla; *r.* rostrum.

extension backwards and flattening out of the paragnaths, the limb slopes obliquely forwards and the tips of the setae lie almost in a frontal plane.

Thus the main mass of the maxilla forms a comb of setae lying close against the body wall (the paragnaths) and extending some considerable distance behind the mouth. The morphologically posterior face of the limb is thus ventral and will be referred to as the ventral surface. The remainder of the limb projects forwards on either side of the mouth underneath the maxillules (Fig. 4 A).

The setae are closely set with fine setules on the ventral surfaces, especially so at their bases. Distally the setules are spread out so that the setae appear feathered at the tips (Fig. 4 A). Immediately lateral to the bases of the setae the proximal endite bears a row, or rather a strip, of closely set minute setules which project ventrally across the space between the maxilla and the first trunk limb (Figs. 4 A, 5 A; Thiele, 1904, Pl. 3, fig. 49).

The first trunk limb, which differs markedly from the more posterior limbs, lies close against the maxilla. Its posterior face is thus ventral, and the limb can be said to lie close underneath the maxilla. It bears a proximal endite which corresponds closely in shape and general structure with that of the maxilla. Its setae, however, are armed with setules on their upper and not their lower faces, and at the base of the setae, it carries a strip of closely set minute setules just as in the case of the maxilla, but again these are on the upper and not on the lower surface (Figs. 4 B, 5 A).

The endopodite consists of a lobe bearing a few powerful setae projecting forwards immediately underneath the tips of the maxilla and maxillule (Fig. 4 B). The exopodite projects ventrally, and, in the specimen F_2, appears to be divided into two parts—an anterior lobe and a posterior flat plate armed at the edges with long setae. Directly behind this posterior part and forming a functional continuity with it, is the large plate which has been homologized with the epipodites of the other trunk limbs. This is a very thin plate from the edge of which project setae of approximately the same length as the width of the plate. It spans completely the lateral gap between the first and second trunk limbs (Fig. 3). The antero-lateral margin of the base of the limb projects forwards and upwards around the side of the maxilla thus tending to close the space between them (Fig. 5 A).

The shape and arrangement of a typical trunk limb can be seen from Figs. 2 and 3. It will be noticed that the limbs are all parallel to the maxilla and first trunk limb, thus sloping obliquely forwards. They are wider apart anteriorly than posteriorly and the inner edges of the limbs are nearer to the body wall than the outer.

Trunk limbs 3 to 7 are closely similar in structure and are referred to as the typical trunk limbs. They are unsegmented, the exopodite being represented by a slight projection ending in a strong spine towards the tip on the outer margin. The endopodite must be considered as the tip of the limb distal to this exopodite lobe. The epipodite is attached at about a third of the way up the limb and projects backwards as a very slightly bilobed structure. It should be called a lobe rather than a plate, as it is comparatively thick and differs markedly in this respect and also in the fact that it bears no

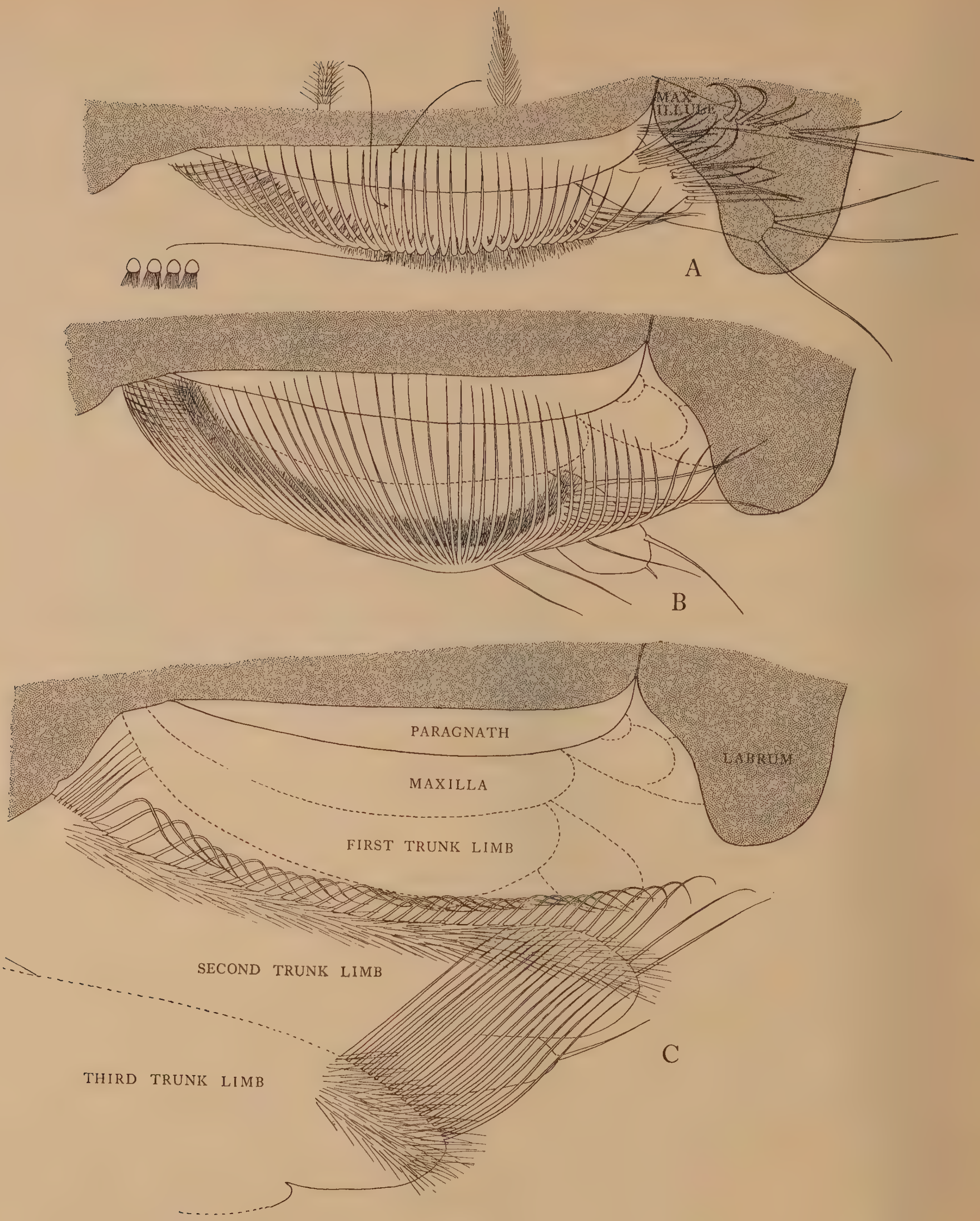
MAXILLULE
A
B
PARAGNATH
MAXILLA
LABRUM
FIRST TRUNK LIMB
SECOND TRUNK LIMB
C
THIRD TRUNK LIMB

Fig. 4. *Nebaliopsis typica*. Views of maxillule, maxilla, first, second and part of third trunk limbs. (For comparison with *Nebalia*, Text-fig. 4, Cannon, 1927, p. 361.)

A. Maxillule and maxilla. To the left and above are enlarged views showing the setules on a filter seta near its base, in the middle region and at the tip.

B. First trunk limb.

C. Second trunk limb and part of third.

marginal setae, from the thin plate-like epipodite of the first trunk limb. A still more important difference is that these epipodites do not nearly cover the lateral gaps between successive trunk limbs (Figs. 1, 3).

It may be conveniently mentioned here that it is a complete puzzle as to how a female *Nebaliopsis* carries its embryos, if indeed they are carried. In all other Nebaliacea the tips of the endopodites of the typical trunk limbs curve inwards and form a basket under the trunk (compare Fig. 6 of *Nebaliella*) but this cannot be possible in *Nebaliopsis*.

The inner margin of these trunk limbs are armed with setae just as are the trunk limbs of *Nebalia*. On each limb there are two distinct sets. One row consists of very long setae which extend forwards as far as the inner margin of the limb in front. The second set is an irregular strip of minute setae which project inwards and touch the tips of the long setae from the limb behind (Fig. 5 A). There is thus a zigzag of setae forming, on each side, the wall of the median space between the limbs, but the setae are not interlocked as in *Nebalia*. The first set are undoubtedly homologous with what I have termed the first row setae of *Nebalia* (1927, p. 359). The second set may represent the fourth row setae of *Nebalia* or may be the fourth and third rows combined.

The second trunk limb differs from the typical trunk limb in that its first row setae, with the exception of the six proximal setae and two or three of the most distal, instead of projecting straight forwards, project obliquely inwards and then curve backwards (Fig. 4 C). The six proximal setae are shorter and project directly forwards. They correspond to the gnathobasic setae of *Nebalia*.

The eighth trunk limbs are very small and bear no setae. The main axis shows a slight segmentation which probably separates off the distal endopodite.

The pleopods and furcal appendages have been sufficiently described by Thiele (1904, p. 23).

From the account I have given of the arrangement of the limbs, it is obvious that the feeding mechanism of *Nebaliopsis* must differ considerably from that of *Nebalia*.

In *Nebalia* all the eight trunk limbs project almost at right angles to the body on either side of a median space—the filter chamber. Their endopodites recurve sharply backwards and slightly inwards so that their tips touch in the middle line. A floor is thus formed to the filter chamber. The eighth trunk limbs interlock in the middle line and so form the hind wall. The lateral walls are formed on either side by a continuous series of interlocked setae borne on the inner margins of the limbs, two sets of setae on each limb (the first and third rows) hooking into the setae of the limbs fore and aft. Thus the only entrance to the filter chamber is anteriorly. Water is sucked in through this opening by the rhythmical movement of the trunk limbs and caused to pass through the filter walls between the trunk limbs to the exterior, the food particles being retained in the filter chamber. The passage of water in one direction through this filter system is made possible by the valvular arrangement of the exopodites and epipodites. On each limb these structures form a complete valve closing the space laterally between that limb and the limb behind. The whole of the filter apparatus is supported by the carapace which completely covers the trunk limbs.

In *Nebaliopsis* the trunk limbs project obliquely forwards, their endopodites being in a line with the rest of the limb. The limbs are wide apart and the median space between them is open ventrally. The eighth trunk limbs are without setae. The second to seventh trunk limbs bear setae which form a complete wall to the median space but the setae of one limb are not hooked on to those of adjacent limbs. Further, the exopodites are minute and, with the exception of the first trunk limb, the epipodites do not cover the spaces between successive limbs. The carapace, in an average specimen, extends back only to about the fourth trunk limb. In all specimens the lateral margins of the carapace are wide apart and not close together in the middle line as in *Nebalia*.

There are thus very few points of resemblance between the two forms, but I believe it is possible, with a fair degree of certainty, to suggest the mechanism by which *Nebaliopsis* obtains its food.

Nebaliopsis is, I believe, entirely a filter feeder. The molar process of the mandible is represented by a small soft protuberance (Thiele, 1904, p. 21) which must serve as a lateral lip rather than as a masticatory process. The whole mouth armature is extremely soft and quite unsuited for dealing with large food particles. In addition, there is a complicated structure which, in my opinion, must be a filter.

The consideration of the feeding mechanism can be divided into two parts. The action of the second to seventh trunk limbs, and the action of the maxilla and first trunk limbs, which I believe represents the actual filtratory mechanism.

The eighth trunk limbs, from their separation from the more anterior limbs and from the fact that they bear no setae, most probably take no part in the feeding process.

In this analysis I make two assumptions. Firstly, I assume that the typical trunk limbs exhibit a metachronial rhythm in their movement of the type that I have described in detail for *Nebalia* (1927, p. 357) and *Chirocephalus* (1928, p. 816). That is, every limb commences its backstroke just before the limb immediately anterior to it. I have previously suggested (1928, p. 816) that all Crustacea exhibit primitively this type of movement, and I see no reason for assuming that *Nebaliopsis* is, in this respect, different from *Nebalia*. Secondly, I assume that the typical trunk limbs depend to a great extent on their turgidity, that is on their blood-pressure, for rigidity. I believe that this assumption is justified from the fact that the distal two-thirds of each limb is devoid of musculature. Also the cuticle is so thin that it is difficult to imagine any movement being possible in so large a limb without some internal pressure to inflate it. The trunk limb, in these respects, is markedly different from the powerful swimming pleopods which are full of musculature and carry a comparatively thick cuticle.

In Fig. 5 C I have drawn an outline sketch of the seventh pair of trunk limbs seen ventrally and a median aspect of one of these limbs to illustrate the musculature. It will be seen that each limb articulates on a rigid boss or prominence from the body wall (see also Figs. 1, 3). The limb contains two chief muscles. One comparatively powerful muscle is attached in the limb close against the ventral body wall at the base of the first row setae. It extends backwards and attaches to the body wall at the base of the boss. I call it the flexor muscle. Its contraction must tend to lift the tip of the limb towards the body wall and, at the same time, it must swing the tip round towards the middle line.

The recovery of the limb back to the position shown in Figs. 1 and 2, must be mainly due to the blood-pressure, but it is probably aided by the other muscle in the limb. This, the extensor, is markedly smaller than the flexor. It is attached to the ventral surface of the limb just below the anterior attachment of the flexor, and runs ventro-posteriorly to a point of attachment near the tip of the boss. From Fig. 5 C it will be seen that it also runs postero-laterally. Its contraction must therefore tend to swing the tip of the limb outwards and downwards.

Thus the typical trunk limb oscillates in metachronial rhythm, moving up and down towards the body wall and against the limb in front, the tips of each pair of limbs approaching each other as they move upwards.

The result of this movement is, I believe, a general drift of water away from the limbs. As each limb moves upwards it throws out the water between it and the limb in front. The tip of the limb will be moving fastest, the base not at all. It will touch the limb in front and so occlude completely the inter-limb space in this region. Thus the water towards the tip of the limb will be forced outwards. It will pass out mostly between the ends of the two limbs and the epipodite which stretches between them laterally. The forward drift will obviously be more pronounced anteriorly where the carapace covers the limbs laterally.

A simpler way of considering the limb movement is to look on each limb as an oar used as a scull over the stern of a boat. The oar produces, or tends to produce, a movement of water away from the boat along the length of the oar. The limb, I believe, acts in a similar manner.

To replace the water thrown forwards, water will drift towards the body from all directions in the hinder part of the trunk. Anteriorly the trunk is covered by the carapace so that water cannot pass in laterally and, in addition, the momentum of the moving mass of water passing forwards over the limbs will suck in the surrounding water, but this will be drawn into the stream and not into the inter-limb spaces.

Now this is totally different from the conditions in *Nebalia*. Here, all the water which passes into the inter-limb spaces, is sucked from the mid-ventral chamber through the filter wall. In *Nebaliopsis*, while there are filter walls to this median space, there are no valves on the outer sides of the limbs to cause such a suction. On the contrary, there is a large open space dorsal to the attachment of the epipodite which, as far as I can see, cannot be closed however the limb oscillates, and this must be at least one of the passages for water entering the inter-limb space. There is also a gap distal to the epipodite and there is nothing to hinder water entering here as well.

I have summarized what I believe to be the main water currents around a feeding *Nebaliopsis* in Fig. 5 B. Now the passage forwards of a definite stream over the surface of the limbs must mean that there will be a drift in the same direction between the limbs in the mid-ventral space. I do not mean that there will be a marked anteriorly directed current towards the mouth as in *Chirocephalus*, but it is impossible to imagine the water moving forwards on either side without the central mass of water moving in the same direction. Of course this would not apply if there were not the wide open space ventrally between the limbs.

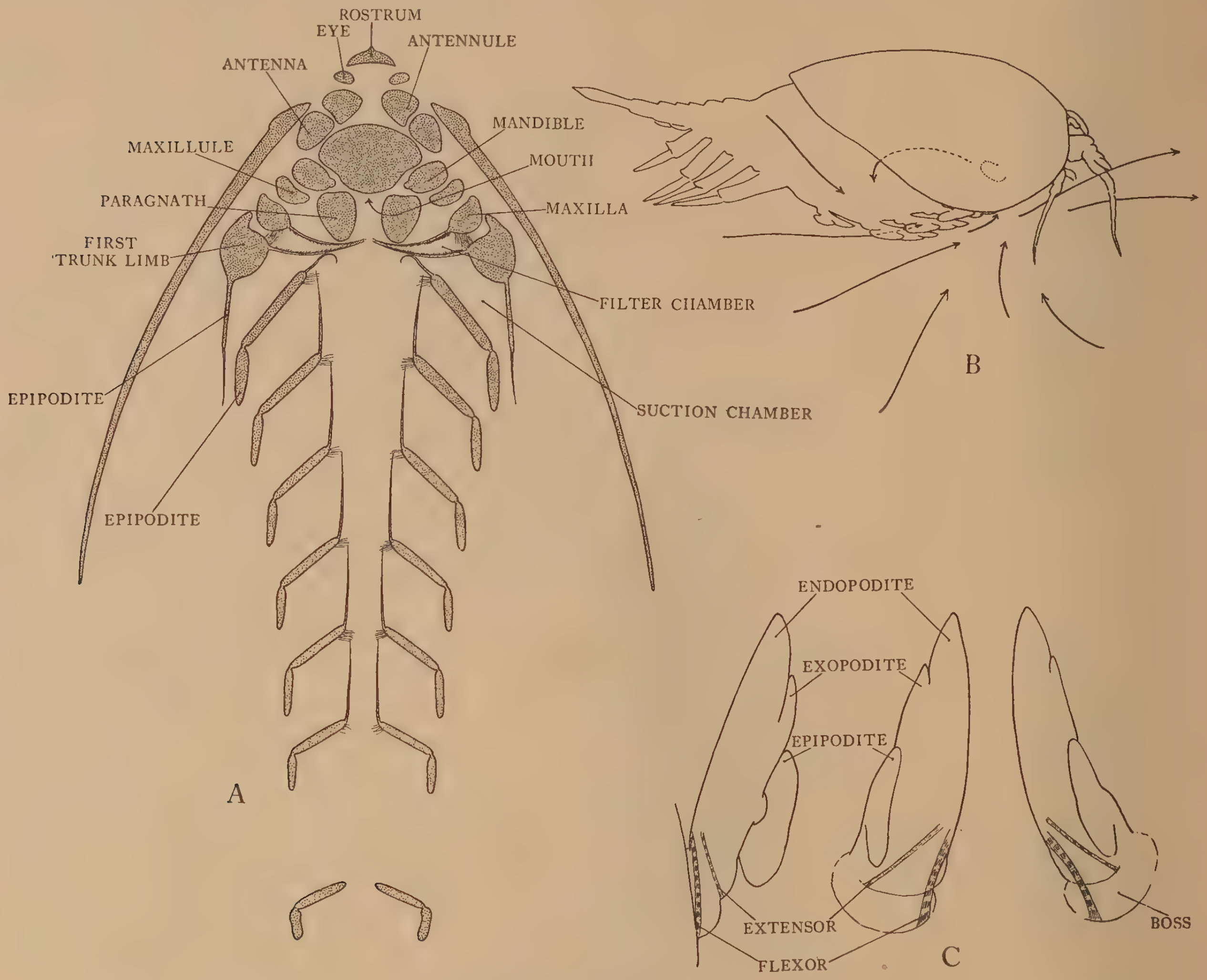
ROSTRUM
EYE
ANTENNULE
ANTENNA
MANDIBLE
MAXILLULE
MOUTH
PARAGNATH
MAXILLA
FIRST TRUNK LIMB
FILTER CHAMBER
EPIPODITE
SUCTION CHAMBER
EPIPODITE
A
B
ENDOPODITE
EXOPODITE
EPIPODITE
EXTENSOR
BOSS
FLEXOR
C

Fig. 5. *Nebaliopsis typica.*

A. Diagram of hypothetical curved frontal section passing through all the head and trunk limbs, to show the constitution of the filter apparatus and the arrangement of setae on the posterior trunk limbs. (For comparison with *Nebalia*, Text-fig. 1, Cannon, 1927, p. 357.)

B. Sketch to show suggested water currents.

C. Median and ventral views of seventh trunk limbs to show musculature.

This current will be greatly increased, as I shall describe below, by the activity of the maxilla and first trunk limb. Any food particle carried on it will be retained in the median space by the filter walls, just as in the case of *Nebalia*. As a limb moves backwards and so increases the inter-limb space in front of it, there must be a slight suction from the mid-ventral space, although, as I have just stated, most of the water will pass in through the lateral gaps. This will suck particles on to the long filter setae of the limb. They will be swept off again into the mid-ventral space by the strip of short setules of the limb in front (Fig. 5 A) just as, in the case of *Nebalia*, the fourth row setae sweep particles off the first row. It is for this reason that I suggested that the setules immediately behind the long first row setae may be homologous with the fourth row setae of *Nebalia*.

From Fig. 2 it will be seen that the combs of setae on the protopodites of the first trunk limbs are largely exposed ventrally so that, if these setae and the maxillary setae which they cover act as filters, there is this open ventral space from which water can be drawn for filtering. In addition, if what I have argued above is correct, there is a continuous stream from behind and more particularly a forward current in the mid-ventral line which will be laden with food particles kept there by the setae of the trunk limbs.

The structure of the maxilla and first trunk limbs, in my opinion, indicate that they must act as true filters. If this is so, it must be possible to demonstrate an actual filter chamber and a mechanism by means of which water is caused to pass through that chamber, and further, a means by which the filter itself can be cleaned and the residue passed on to the mouth.

The filter chamber is the inter-limb space between maxilla and first trunk limb. It is a thin curved space close against and parallel to the body wall and roofed by the filter comb of the maxilla (Fig. 5 A). The setae of this comb are armed with setules which point downwards into the chamber so that, if water passes through this comb from the chamber, any particles will be retained on the setules. The extent of these setules is shown in Fig. 5 A where three enlarged drawings are shown of the setae near the base, in the middle region and at the tip. These figures were drawn from an isolated maxilla which was viewed from the median plane under a high-power binocular. The arrangement of setules at the base of the setae was confirmed from the series of parasagittal sections.

The floor of the filter chamber is formed by the filter comb of the first trunk limb. Here again, the setae are armed with setules, and they point this time upwards, into the chamber. As before, they would retain any particles carried by water if the latter passed through them out of the filter chamber.

There are no real walls to the filter chamber medianly, anteriorly or posteriorly, as, in these directions, the tips of the setae of the first trunk limb touch the corresponding setae of the maxilla; but laterally, the chamber is bounded by the mats of setules which project downwards from the maxilla and protrude into the similar setules which project upwards from the first trunk limb (Fig. 5 A). This lateral wall must not be looked on as a setal wall through which water could pass. It may be described as a solid mass of setules and I believe it is just as effective as a solid wall would be.

The manner by which water is drawn into this filter chamber is not very precise. When the maxilla and first trunk limbs are lifted up from the body their inter-limb space, that is, the filter chamber, must enlarge. Water will be sucked in and will pass from the mid-ventral space through the tips of the setal combs. It cannot pass in laterally because of the solid mat of setules. Some of the particles in the stream will be entangled on the tips of the setal combs. The remainder will pass into the chamber and these, as I have explained, cannot get out. They will be caught on the setules of the filter setae.

When the limbs move up again towards the body, this, in itself, will diminish the volume of the filter chamber and so tend to force out its contained water. However, a real suction pump exists which actively sucks water out of the chamber. This is formed by the first and second trunk limbs, and their inter-limb space I call the suction chamber (Fig. 5 A). The valve of the pump is provided by the epipodite of the first trunk limb which, as I have explained, completely covers laterally this inter-limb space. When the second trunk limb moves backwards it will tend to increase the volume of the suction chamber and hence water will be sucked in. Now this cannot pass in laterally as in the case of the more posterior trunk limbs for the epipodite will flap against the second trunk limb and act as a closing valve. Some will pass in from the mid-ventral space and will be filtered on to the setae of the second trunk limb, but the majority will be sucked out of the filter chamber.

From Fig. 2 it can be seen that the suction chamber is roofed by the filter setae of the first trunk limb. This is most clear on the right-hand side of the figure. When the second trunk limb is dragged backwards its tip will probably touch the limb in front. The suction chamber is now closed ventrally and also laterally by the epipodite. Water sucked in must hence pass either from the median space or through the roof of the chamber, that is, from the filter chamber. From Fig. 5 A it can be seen that this roof forms a much greater area than the median wall and so it is probable that the majority of the water passes in through the roof.

Water drawn from the filter chamber into the suction chamber will pass out backwards when the second trunk limb moves forwards relatively to the first. When this happens the space between the two limbs will diminish and so water will be forced out. The epipodite will now flap outwards and allow a free passage posteriorly exactly as in the case of the combined exopodites and epipodites of *Nebalia*.

The peculiar re-curvature of the first row setae of the second trunk limb is difficult to explain. I can only say that if they projected directly forwards in the same direction as the homologous setae of the more posterior trunk limbs, they would project right through the filter apparatus and interfere with its functioning. The direction of the setae of the second trunk limb is, on the whole, at right angles to those of the first trunk limb. The curved setae thus lie across the filter setae, and I suggest that they act as a sort of buffer to the latter preventing them being forced backwards too far when the filter chamber is diminishing. They could not act in this way, even with their re-curvature, if they pointed in the same direction as the filter setae as they would slip in between the latter.

The particles of food filtered off on to the walls of the filter chamber have now to be transferred to the mouth. One of the most striking things about *Nebaliopsis* is the distance the filter apparatus extends behind the mouth. It is of no use a limb filtering off food particles if there is no means of transferring these to the mouth and hence the posterior part, at least, of the filter would be useless unless a suitable mechanism for the purpose existed. The process of transference is, I believe, carried out entirely by the mandibular palps. The length of these structures is just sufficient to allow them to bend back as far as the hinder limit of the filter chamber. Also, they are jointed in such a way that the tips can be folded back into the mouth entrance and the tips are armed with comparatively stout claw-like setae armed with a brush of setules. I believe they stroke upwards so that their distal setae project through the filter setae into the chamber and then inwards and forwards to the mouth, thus combing the filtered residue to the mouth entrance. Here it is sucked into the mouth by the powerful dilator musculature of the oesophagus.

I have said nothing as to the actual phase differences between the oscillations of the mouth parts. I assume that the trunk limbs behind the first exhibit the typical metachronial rhythm, but exactly how the mouth parts oscillate I think it impossible to say.

To summarize the feeding mechanism as far as I have analysed it—it is suggested that the second to seventh trunk limbs, by their oscillation, produce a drift of water forwards over the mouth parts. This will cause a subsidiary current along the mid-ventral line towards the mouth, and particles in this current will be retained there by the filter setae arming the inner margins of these trunk limbs. Water arriving at the mouth region will be sucked into a filter chamber between the maxilla and first trunk limb when these limbs move downwards from the body wall. It will be sucked out by the backward movement of the second trunk limb, the epipodite of the first trunk limb acting as a valve closing laterally the inter-limb space between the first two trunk limbs. Particles filtered off in this way on to the filter setae of the maxilla and first trunk limb are scraped off and passed forwards by the mandibular palps into the mouth.

Nebaliopsis is without doubt the most specialized of the Nebaliacea (Thiele, 1904, p. 25). Of the other members of the group I have described the feeding mechanism of *Nebalia* from actual observation (1927). In the next part of this report I give evidence that the principle of the feeding process of *Nebaliella* is the same as that of *Nebalia*. Although I have not been able to examine a complete *Paranebalia* I believe, from the published accounts of this genus, that it also feeds in a similar manner. Thus the *Nebalia* mechanism can be taken, in general principle, as representing the primitive feeding mechanism of the Nebaliacea, and it must be assumed that the method of feeding of *Nebaliopsis* has evolved from it.

How this has come about is very difficult to say and will remain so until new forms are found less divergent from other Nebaliacea than *Nebaliopsis*. But, that the change took place in correlation with the planktonic habits of *Nebaliopsis*, is, I think, certain. It is possible to imagine a *Nebalia* adopting a pelagic habit. In fact, certain of the specimens recorded in this report were collected at the surface (p. 221), but I cannot conceive a *Nebaliopsis* living in mud. For this reason I take it that *Nebaliopsis* evolved from a planktonic *Nebalia*.

Such a form, I suggest, developed the maxillary-first trunk limb filter mechanism, at first, to aid its more posterior trunk limb filter, just as I have suggested in the evolution of the primitive Malacostracan the maxillary filter developed to assist the trunk limb feeding mechanism (1928, p. 820). Then, when this became sufficiently advanced, it opened up the carapace—maybe to allow a greater inflow of water on to the maxillary region. At this stage water would enter the mid-ventral space, not only anteriorly, but also ventrally. The maxillary filter now became the chief feeding mechanism and, with further evolution, became greatly enlarged. As it developed so the carapace widened out and water came to be sucked in from all directions. The trunk limb filter was then almost abandoned, the trunk limbs swinging forwards to act as a subsidiary mechanism supplying water to the primary maxillary-first trunk limb filter.

On these arguments *Nebaliopsis* shows an interesting parallel to *Nebalia*. I pointed out (1927, p. 367) that the ancestor of *Nebalia* was a filter feeder and that, in its evolution "the primitive filtering mechanism disappeared, and with the re-establishment of a filtering method of feeding the original mechanism did not return, but an entirely new method was established" (1927, p. 368). Now this filter mechanism of the ancestral Nebaliacean, lost in *Nebalia*, was a maxillary filter (Cannon and Manton, 1929, text-fig. 1) and, in the evolution of *Nebaliopsis*, a maxillary filter has been re-established, but it is an entirely new apparatus—a combination of maxilla and first trunk limb, which is otherwise unknown in the Malacostraca.

Nebaliella extrema, J. Thiele

The genus *Nebaliella* was established by Thiele in 1904 to include two specimens collected by the 'Valdivia' in the neighbourhood of Kerguelen, and a single incomplete specimen collected about 1875 by the 'Gazelle' from the same locality. He described them under the name *Nebaliella antarctica*. He suggested also that a specimen in the Copenhagen Museum, which was collected in Akaroa Harbour, New Zealand, is a young individual of this species. In 1908 he described another species, *N. extrema*, from fifteen specimens collected by the 'Gauss' off the coast of Kaiser Wilhelm II Land. Among the Discovery material there is a single complete and undamaged specimen of this latter species collected in the Palmer Archipelago.

The following list gives details of the localities in which *Nebaliella* has been found:

Table II.

Expedition	Locality	Lat.	Long.	Depth
N. antarctica				
Gazelle, 1875	Kerguelen	48° 30′ S	69° 40′ E	9 m.
Valdivia, 1898–9	Kerguelen	48° 30′ S	69° 40′ E	5–10 faden
(Copenhagen Museum)	Akaroa Harbour, N.Z.	43° 50′ S	172° 55′ E	—
N. extrema				
Gauss, 1902–3	Kaiser Wilhelm II Land	66° 2·9′ S	89° 38′ E	380–385 m.
Discovery, 1927. St. 181	Palmer Archipelago	64° 20′ S	63° 1′ W	160–335 m.

Thiele does not figure or give measurements of *N. extrema* but from his account it is to be presumed that it did not differ markedly in general shape and size from *N. antarctica*. He gives measurements of the latter species but, unfortunately, they do not tally with his drawing. According to his figures the carapace should appear larger proportionately to the rest of the body than in his illustration. If this correction is made the general shape and proportion of the body agree with the Discovery specimen of *N. extrema*.

The chief dimensions of the Discovery specimen are:

Carapace length	5·45 mm.
Carapace depth	3·65 ,,
Length of rostrum	1·3 ,,
Length of flange of rostrum	0·65 ,,
Width of flange of rostrum	0·43 ,,
Length of eye	1·6 ,,
Length of caudal furca, excluding terminal spines ...	2·1 ,,
Total length from tip of rostrum to tip of caudal furca	11·5 ,,

The three main characteristics of the genus *Nebaliella* are the peculiar form of the rostrum and eyes, the fact that the third and fourth joints of the antenna are separate and armed with stout spines, and the absence of epipodites on the trunk limbs. Of these, the latter distinguishes *Nebaliella* from all other Nebaliacea, but, from a functional standpoint, it is the least important characteristic.

The morphology of the trunk limbs has been described in detail by Thiele (1904, p. 7; 1905, p. 64). Apart from the absence of epipodites they are closely similar to the trunk limbs of *Nebalia*. I have studied their arrangement in the Discovery specimen and find it identical with that of *Nebalia*. As will be seen from Fig. 6, the specimen is an adult female carrying embryos. These were held by the tips of the endopodites curving backwards and inwards to form a complete basket under the trunk and a floor for the filter chamber between the trunk limbs. The walls of the filter chamber are constituted as in *Nebalia*, each trunk limb carrying four rows of setae along its inner margin. The first and third rows are long and form the actual filter wall. The second consists of a few long feathered setae near the base of the limb and the fourth row, of short setae on the hinder face of the inner margin, projecting inwards and backwards through the first row setae of the limb behind. I could not settle whether the first and third rows of successive limbs interlocked as in *Nebalia* as, in removing the embryos in order to study this setation, the setae were naturally displaced. The eighth pair of trunk limbs are close together in the middle line and form the hinder wall to the filter chamber just as in *Nebalia*.

On cutting away the carapace on one side, I found that, although the epipodites were absent, the exopodites were, proportionately to *Nebalia*, much larger, each exopodite completely covering the lateral space between its limb and the limb behind. That is, the exopodite of *Nebaliella* has taken the place of the combined exopodite plus epipodite of *Nebalia* which I showed (1927, p. 358) acted as valves allowing the passage of water from the filter chamber between the limbs to the exterior at the hind end of the carapace.

In *Nebaliella* then, the trunk limbs are arranged in the same way as in *Nebalia*, their setal armature is the same, and their exopodites take the place of the exopodites and epipodites of *Nebalia*. It is legitimate to deduce that *Nebaliella* is also a filter-feeding organism and that the principle of its filter mechanism is the same as that of *Nebalia*.

Nebaliella, like *Nebalia*, is undoubtedly a mud-living form. In fact, the anterior portion of the Discovery specimen was covered with a layer of mud which had to be removed before its limbs could be studied. The shape of the rostrum and eyes and the armature of the third and fourth joints of the antenna, which, as I have explained, are the other characteristics of the genus, are, I believe, adaptations to this burrowing mode of life. In *Nebalia* I suggested (1927, p. 356) that the rostrum functions in controlling the current entering the filter chamber. This has been carried to extremes in *Nebaliella* and, the animal being apparently blind (Thiele, 1904, p. 4), the eyes have become modified in structure and incorporated into this rostral controlling mechanism. Briefly put, the eyes and rostrum together form a plough which forces the mud to the sides and so prevents the filter mechanism becoming choked as the animal forces its way through the mud by means of the powerful claws on the antennae.

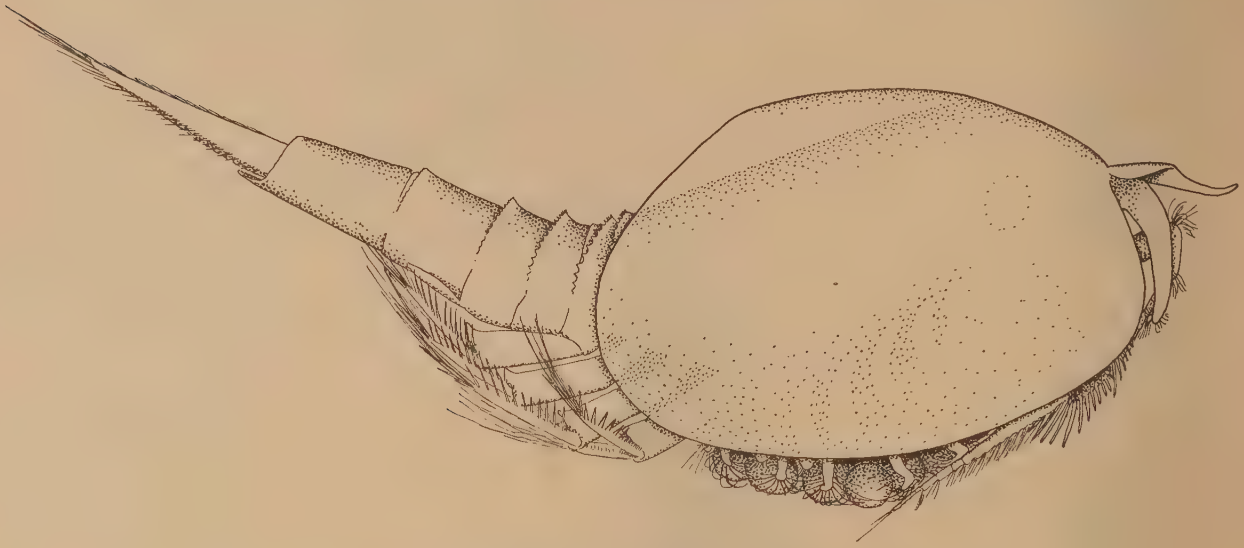

Fig. 6. *Nebaliella extrema*. Side view.

The shape of the rostrum and eyes has been described in detail by Thiele (1905, p. 61). They are figured in Fig. 7 in lateral aspect and when viewed obliquely from in front and below. It will be seen that the rostrum consists of a median keel with lateral flanges posteriorly. The eyes are excessively thin scythe-shaped plates. The planes of the eyes are approximately at right angles, each projecting antero-laterally. Thus, in Fig. 7 B, the right eye, which is being viewed in the direction of its plane, shows its thinness, while the left shows its outline. The eyes articulate below the lateral flanges of the rostrum, the convex anterior margin extending up to a point immediately underneath, and slightly median to, the outer edge of the flange. The articulation is thus covered dorsally by the rostral flange.

The concave posterior margin of the eye is produced into a heel near its upper limit which presses backwards against a knob just above the attachment of the antennule. This knob has been described and figured by Thiele (1905, Pl. 2, fig. 3) but the specimen from which the figure was drawn must have been badly distorted.

Attached to the outer surface of the eye at about the middle of its length and near the lower margin is a muscle which runs backwards and inwards to attach to a median point just below the hinge of the rostrum. By contraction of this muscle the eye would tend to be drawn backwards and inwards. However, its backward movement is restricted by the posterior heel. From the lateral view in Fig. 7 A, it will be seen that this heel is lodged in a gap between the antennulary knob and the antennule itself. Contraction of the eye muscle can, therefore, only have one action. It must cause the eye to pivot about this point. This will make the anterior margins of the eyes rotate inwards towards the middle line. Now the eyes form the lateral margins of the anterior entrance to the filter chamber—the only entrance by which food-bearing water is sucked in—and their rotation inwards will diminish the size of this entrance. There is thus in the eyes a mechanism by which the amount of water, and hence the amount of food, entering the carapace can be controlled.

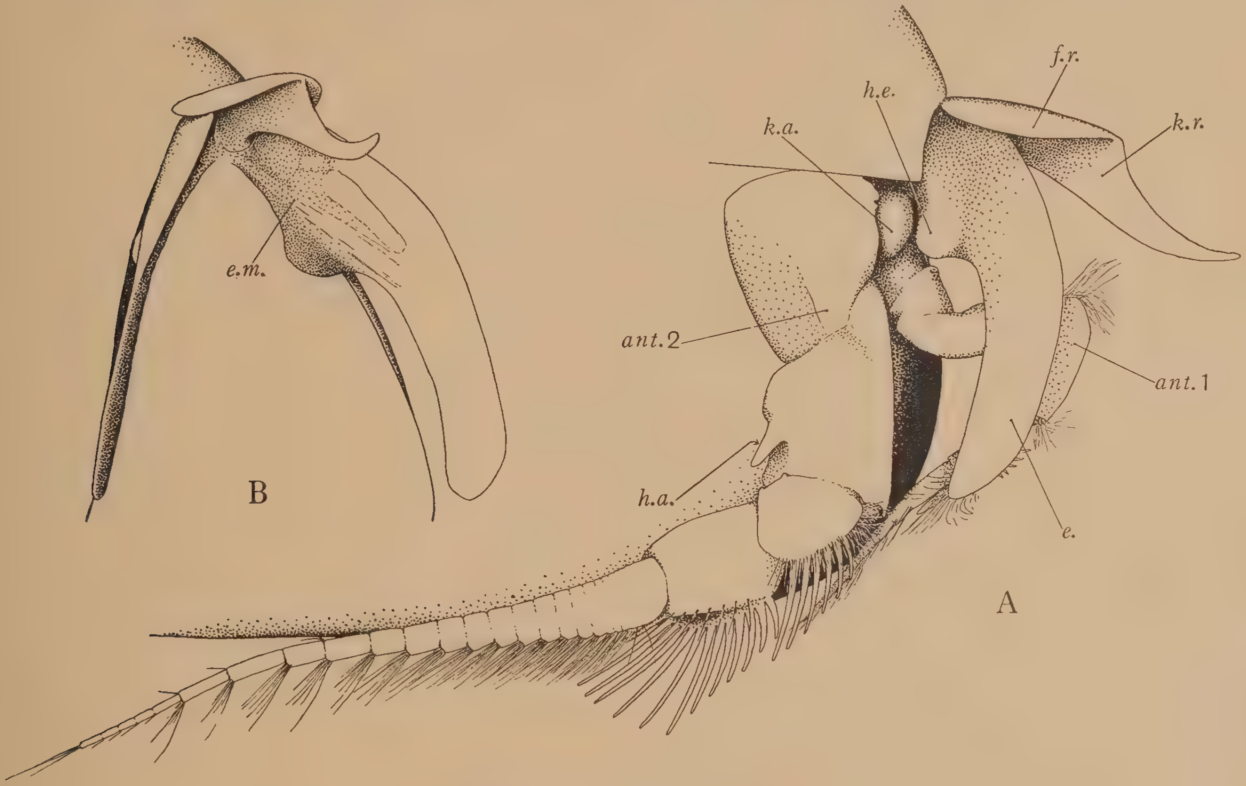

Fig. 7. *Nebaliella extrema.*

A. Side view of rostrum, eyes, antennules and antennae, the right half of the carapace having been partly cut away.

B. Oblique front view of eyes and rostrum.

ant. 1, antennule; *ant.* 2, antenna; *e.* eye; *e.m.* eye muscle; *f.r.* flange of rostrum; *h.a.* hook on second joint of antenna; *h.e.* heel of eye; *k.a.* knob above antennule; *k.r.* keel of rostrum.

When a *Nebalia* burrows in the mud it depresses its rostrum and partially closes its carapace so that the front end of the carapace will not become swamped with mud and the feeding mechanism choked. I assume that *Nebaliella* behaves in the same way.

Now when the rostrum of *Nebaliella* is depressed the eyes must automatically rotate inwards. In fact, as will be seen from Fig. 7, the rostrum cannot be depressed without the eyes first of all shifting in some way, since the upper limit of the front margin of the eye rests against and appears to support the under surface of the flange of the rostrum. The flange, however, is not flat but concave ventrally (Fig. 7 B). Its ventral surface thus faces downwards and inwards. Pressure of the flange on the upper margin of the eye must therefore force the latter inwards and, since the eye is lodged by its heel against the base of the antennule, this pressure can only have one result, that of rotating the eyes inwards.

As the depression of the rostrum continues the eyes will swing inwards until the upper parts of their anterior margins come to lie alongside the median keel of the rostrum. The latter will then be gripped between the eyes and, together with them, will form a lid tending to close the anterior opening between the valves of the carapace. This lid cannot be further depressed on to the carapace edges unless the eyes can move backwards.

On burrowing, as I have stated above, I assume that *Nebaliella* partially closes its carapace. In order to do this, it must withdraw its antennules or, at least, their upper parts, backwards into the carapace. This will allow the heel of the eye to move slightly backwards, and this, in turn, will allow the rostrum to fold down to its maximum extent until its flanges rest on the anterior edges of the carapace, the tips of the eyes passing just inside the carapace.

Thus when a *Nebaliella* is burrowing the rostrum and eyes together form a lid closing the upper and greater part of the anterior opening of the carapace. It is possible that the distal parts of the antennules will project as sensory feelers through the lower part of this opening just ventral to the tips of the eyes. But for the greater part this gap will be closed by the massive third and fourth joints of the antennae.

From Fig. 7 A it can be seen that the first and second joints of the antennae are of such a length that the powerful spines on the third and fourth joints project just beyond the edges of the carapace (Fig. 6), and I suggest that these are the structures which *Nebaliella* uses to push itself through the mud. They do not occur in any other Nebaliacean and it is possible that they have some other function, but it is because of their strength and arrangement, and from the fact that, in the Discovery specimen they were completely covered with mud, that I suggest that they form the chief burrowing organ. They are situated along the inner lower margins of the two joints and, on the fourth joint along the inner edge of a ridge under which fits closely the edge of the carapace. The latter can thus be almost closed ventrally and yet allow these antennal claws to project.

The separation of the third and fourth joints supports my suggestion, as, separated, they have much greater power for gripping the mud than if they were fused. In the latter case a movement of the whole antenna would be necessary for them to dig into the mud, while as they are, they can do this by rotating about their common joint and about the joint between the third and second segments.

The antennae, during digging, will be drawn forwards as far as possible. This will give the claws a bigger pull and so increase their efficiency for burrowing.

Now the combined action of the eyes, rostrum and antennae will have a further result, and that is, that the tip of the eye must catch on the peculiar hook on the hinder margin of the second joint of the antenna. The hook is so placed that, as far as I can see, the eye cannot rotate backwards without catching on it and, further, it is of just such a shape that the tip of the eye fits into it perfectly. It has been described and figured by Thiele (1904, p. 5) but he does not suggest any function for it. It occurs only in *Nebaliella*.

The eyes are thus depressed by the rostrum and, at the same time they are gripped from behind by the antennal hooks. As a result they are held firmly in position to form with the rostrum a rigid shield covering the anterior opening of the carapace which will guard this entrance against choking by mud during burrowing.

The function of the pleopods is probably to cause a backward current in the burrow which will carry away the mud kicked up by the antennal claws.

The three main differences between the two species of *Nebaliella* are the form of the rostrum, the number of claws on the third and fourth joints of the antenna and the setation on the outer margins of the pleopods. In all these respects the Discovery specimen agreed with the description of *N. extrema*.

The antennal flagellum of *N. extrema* has not been figured, but, from Thiele's description (1905, p. 63) it is to be presumed that it agrees with that of *N. antarctica* (Thiele, 1904, Pl. 1, fig. 8). The Discovery specimen, however, shows a marked difference from Thiele's figure. He describes the flagellum as of thirty-five joints, of which the second to the fourteenth, the sixteenth, the twentieth and the twenty-sixth carry bundles of sensory setae ("Riechschläuchen"). In the Discovery specimen there are about twenty-three segments of which all except the terminal five carry bundles of these setae. If the segments on Thiele's figure are counted as the gaps between successive bundles and the terminal part counted as five segments then there are twenty-two segments, which agrees fairly closely with the Discovery specimen. It will be seen from Fig. 7 A that the proximal segmentation is obscure. The difference is, I believe, due to the fact that Thiele's specimen was probably a male while the Discovery specimen was a female, for Claus (1889, Pl. 2) has shown that in the male of *Nebalia* the true segments of the antennal flagellum show a secondary segmentation which greatly increases the apparent number of segments.

Nebalia longicornis, G. M. Thomson

Specimens of *Nebalia* were collected from three widely separated localities:

Locality	Depth	No. of specimens	
South Georgia, St. 45	233–270 m.	1	*N. longicornis magellanica*
Falkland Islands, St. 51	105–115 m.	1	*N. longicornis magellanica*
Simon's Town, S. Africa, St. 90	1–2 m.	6	*N. longicornis*

As Calman has pointed out (1917, p. 157, and 1927, p. 399) the classification of the forms of *Nebalia* is, at present, very unsatisfactory. The chief characters on which species are diagnosed are: the form of the rostrum, the setal armature of the fourth segment of the antennule and, to a lesser degree, the form of the eye.

If the second of these characters alone is taken into consideration all the Discovery specimens belong to the species *N. longicornis*, since they all carry on the fourth antennular segment one stout spine followed by five or six more slender spines. Also, the single specimens from South Georgia and the Falkland Islands exhibit eyes with the peculiar dorsal tubercle characteristic of the variety *N. longicornis magellanica* (Thiele, 1904, p. 13, and 1905, p. 66).

Considering the rostrum, however, it is not so easy to give a satisfactory name to the specimens. There seems to be some confusion as to the dimensions of the rostrum which characterize the two forms *N. bipes* and *N. longicornis*. From Calman's accounts it appears that he takes a ratio of length to breadth of the rostrum of about 2:1 as being characteristic of *N. longicornis* while he quotes 2·3:1 as being typical of *N. bipes* (1917, p. 156). I have measured the two figures published by Thiele (1904, Pl. 4, figs. 66 and 70) and the ratios are, for *N. longicornis* 1·73:1 and for *N. bipes* 2·61:1.

The ratios of the Discovery specimens are: St. 45, 2·07:1; St. 51, 2·37:1; St. 90, 2·52:1, 2·40:1, 2·40:1. Thus they all fall in between Thiele's figures over a wide range. It is obvious that, at least in this collection, it is useless to consider rostral measurements and I have accordingly classified the specimens solely on their antennulary armature.

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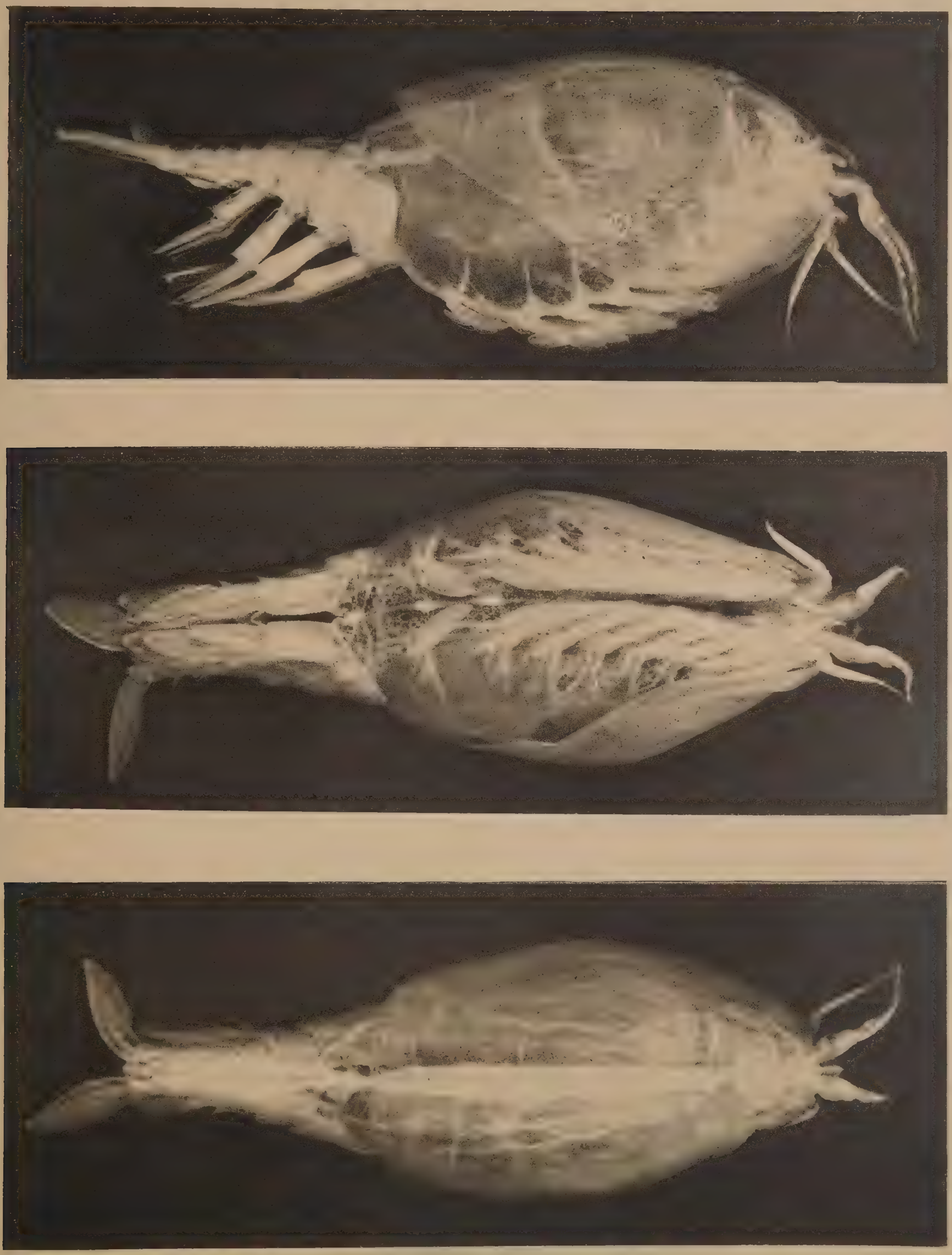
PLATE XXXII

Nebaliopsis typica, G. O. Sars. Lateral, ventral and dorsal views. (× 6.)



Prof. C. J. Patten photo

John Bale [illegible] & Danielsson [illegible] London

NEBALIACEA

[*Discovery Reports. Vol. III, pp.* 223-260, *Plates XXXIII—XXXVIII, text-figs.* 1-7, *November*, 1931.]

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CEPHALODISCUS

By

C. C. JOHN, M.A.

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CEPHALODISCUS

By C. C. John, M.A.

(Plates XXXIII–XXXVIII, text-figs. 1–7)

INTRODUCTION

THE genus *Cephalodiscus* was founded on the material dredged by the 'Challenger' in 1876 from the Straits of Magellan. It was first thought to be a compound Ascidian and later referred to the Polyzoa. In 1887 its structure was satisfactorily worked out by M'Intosh and Harmer (1887) who assigned it to the phylum Enteropneusta.

Although *C. dodecalophus* is the first recorded species, Ridewood (1921) has shown that thirteen pieces of *C. densus* were dredged by the 'Challenger' in 1874 at Kerguelen Island. These were at first supposed to be Monaxonid sponges and later regarded as a kind of hydrozoan allied to *Spongicola fistularis*. They were correctly identified only in 1919 and described by Ridewood in 1921. Material of *C. nigrescens* had been obtained as far back as 1841 or 1842 by the 'Erebus' and 'Terror', but remained unidentified until Ridewood described it in 1912.

Under these circumstances *C. dodecalophus* remained the sole representative of the genus until 1903, when Andersson (1907) announced the rediscovery of *Cephalodiscus* by the Swedish South-Polar Expedition. The Siboga report published by Harmer in 1905 added three new species. In the meantime Masterman and Schepotieff devoted several papers to the further description of the Challenger material. The latter also described an interesting new species, *C. indicus*, from Ceylon.

Lankester (1905) described a new species, *C. nigrescens*, from the Discovery material of the 1901–1904 Expedition. In 1906 Ridewood described *C. gilchristi* from South Africa and in 1907 gave an account (1907 *b*) of the two species which had been dredged by the Discovery Expedition of 1901–1904. Among the collections of the "Scottish National Antarctic Expedition" there were some colonies of *C. nigrescens*, *C. hodgsoni*, *C. solidus* and *C. agglutinans* which were described by Harmer and Ridewood (1913).

Finally when Ridewood (1918 *a*) published his reports on *Cephalodiscus* of the Terra Nova Expedition, he gave a complete synopsis of all the species then known. Before that time it was found necessary to break up the genus into three sub-genera. To these I have found it necessary to add one more sub-genus *Acoelothecia* to accommodate one of the new species, *C. kempi*, of the present collection.

Up to now, sixteen species have been described, including those which are regarded as doubtful forms, and the present Expedition adds two more new species to the list.

The material of *Cephalodiscus* collected during the Discovery Investigations occupies twenty-two jars. Although large quantities were collected from some stations, the yield from others was comparatively poor, consisting of small pieces preserved in tubes. *C. nigrescens* and *C. kempi* were dredged in large quantities, but *C. fumosus* is represented by one piece and the collection of *C. densus* and *C. hodgsoni* is small. When the zooids had been liberated from the coenoecium and fixed in Bouin's fluid, the results were good. But when entire colonies were fixed and preserved, the zooids are not satisfactory for sectioning, for as the colonies were put into the fixing media, the zooids rushed to the ostia and blocked the passages, thus preventing the entrance of the fixing fluid.

Following the Station List already published, the stations of R.R.S. 'Discovery' are denoted by plain numbers and those of R.S.S. 'William Scoresby' are distinguished by the prefix WS. The symbols used for nets, apparatus, etc., are as follows:

DLH.	Large dredge. Heavy pattern, 4 ft. in length (1·2 m.).
H.	Horizontal.
N 7–T.	Net with mesh of 7 mm. (0·28 in.) attached to back of trawl.
N 200.	2 m. tow-net. Mouth circular, 2 m. in diameter (6·6 ft.); mesh graded, at cod-end 4 mm. (0·16 in.).
NRL.	Large rectangular net. Frame 8 ft. long and 2¼ ft. wide (2·45 m. × 0·7 m.), with bag of ½ in. mesh (12·5 mm.).
OTC.	Commercial otter trawl. Head rope 80 ft. long (24·5 m.); mesh at cod-end 1½ in. (3·8 cm.).
OTL.	Large otter trawl. Head rope 40 ft. long (12·2 m.); mesh at cod-end 1¼ in. (3·2 cm.).

The following tables give the geographical and bathymetrical distributions:

Geographical distribution

Name of species	Place	Latitude
C. hodgsoni	Off South Georgia	54°–64° S
	Off South Orkneys	
	Palmer Archipelago	
C. nigrescens	Palmer Archipelago	64° S
C. densus	South Atlantic Ocean (station 82)	32°–64° S
	Palmer Archipelago	
C. fumosus	Off Cape Bowles	61° S
	Clarence Island	
C. kempi	Off South Georgia	49°–53° S
	Between Falkland Islands and South America	

It is interesting to note that all the species of *Cephalodiscus* except *C. indicus*, *C. levinseni*, *C. gracilis*, *C. sibogae*, *C. evansi* and *C. gilchristi* have been obtained from the Southern Ocean between latitudes 49° and 78° S and of these *C. hodgsoni*, *C. solidus*, *C. densus*, and *C. nigrescens* have been recorded within the Antarctic Circle by previous expeditions. The greater part of the present collection was obtained from the neighbourhood of Palmer Archipelago, Falkland Islands and South Georgia lying between latitudes 49° and 64° S. Only one broken piece of *C. densus* is from station 82 (South Atlantic Ocean, 32° S).

Bathymetrical distribution

Name of species	Depth	Number of specimens	Number of stations
C. hodgsoni	93–130 m.	10	4
	259 m.	1	
	160–330 m.	1 (fragmentary)	
C. nigrescens	93–130 m.	Numerous	1
	315 m.	1	
C. densus	75 (–0) m.	1	3
	140–144 m.	1	
	93–130 m.	2	
C. fumosus	342 m.	2 (including a small fragment)	1
C. kempi	75–74 m.	2 (Form B)	11
	79 m.	1 (Form B)	
	82 m.	4 (Form B)	
	118 m.	1 (Form B)	
	146–145 m.	Numerous (Form B)	
	219–133 m.	7 (Form B)	
	200–236 m.	1 (Form A)	
	245 m.	4 (Form A)	
	401–411 m.	Numerous (Form A)	

I take this opportunity of offering my thanks to Professor E. W. MacBride, F.R.S., for getting the materials on his personal responsibility, and for the facilities he afforded me for carrying on this investigation in the Huxley Laboratory under his guidance and supervision; to Dr Stanley Kemp for having entrusted me with the drawing up of the report on *Cephalodiscus*; to Mr H. R. Hewer for suggesting names for the new species and other technical advice; and to Sir Sidney Harmer, K.B.E., F.R.S., for the trouble he took in revising the original manuscripts and for suggesting corrections and improvements which make this paper acceptable for publication.

SYSTEMATIC ACCOUNT

DIAGNOSIS OF THE SPECIES OF *CEPHALODISCUS*

The most important specific structure is the coenoecium. The classification into sub-genera is based entirely on the nature of colony formation. Harmer (1905, p. 4) considers the length of the body and stalk of the zooids as satisfactory specific characters, but measurement of the zooids of some species does not support this. In *C. hodgsoni* the length of the zooids varies from 2 to 32 mm. and that of the stalk from 4 to 10 mm. In *C. densus*, though normal zooids measure 4 to 7 mm., I have obtained giant zooids 11 to 14 mm. long, with a stalk which varies in length from 25 to 40 mm. The number of arms can be used as a specific character, as this is constant for each species except *C. hodgsoni* in which there may be 10, 11 or 12. The number of buds produced can to a certain extent aid in describing the different species. In some species like *C. fumosus* buds are produced profusely, while in others like *C. hodgsoni* the number of buds is only three to five. I doubt whether the production of buds is confined to a definite season. Specimens of the same species dredged at different times of the year show uniformity in the number of buds produced and this fact may be sufficient evidence to show that buds are produced all the year round. Living as they do in the cold waters of the Antarctic Seas, where submarine conditions are similar throughout the year, it is not to be expected that the seasons could have much influence on budding. We might expect to find indications of seasonal changes on the forms from shallower waters such as *C. indicus* from the coast of Ceylon, *C. levinseni* from the coast of Japan or *C. gilchristi* from the South African coast, where the changes are very marked; but reports on these do not mention what influence seasons have on budding. The presence or absence of end-bulbs on the arms, and sometimes (e.g. *C. nigrescens* and *C. fumosus*) the presence of dark lines along the axes of the arms are also characters which help identification.

Sub-genus **Demiothecia**

Cephalodiscus hodgsoni, Ridewood. (Pl. XXXIII, figs. 1–5.)

C. hodgsoni, Ridewood, 1907 *b*.
C. inaequatus (Andersson), 1907.

Diagnosis. Irregularly branched colony without cross bars between branches. Width of branch excluding spines usually 4 to 6 mm.; some basal stems 9 mm. Cavity of coenoecium continuous, the smooth inner lining sometimes traversed by solid bars. Zooids and buds occupy the cavity in common. Older parts of the coenoecium deep amber colour. Ostia numerous, irregularly placed, funnel-shaped and each with two to five simple or forked spines. Zooids: length of a fairly extended zooid from free end of arms to end of body 2 to 3·2 mm. Colour of preserved zooids, reddish or pale brown. Arms, five or six pairs. Axes of each arm have an end-swelling, with refractive beads. Male and female zooids and hermaphrodites occur in the same colony. Buds, two, three or four to each zooid.

Material. The material of *C. hodgsoni* was obtained from the following stations:

St. 167. 20. ii. 27. Off Signy Island, South Orkneys, 60° 50′ 30″ S, 46° 15′ 00″ W. Gear **OTL**. 244–344 m. One specimen.
St. 187. 18. iii. 27. Neumayr Channel, Palmer Archipelago, 64° 48′ 30″ S, 63° 31′ 30″ W. Gear **DLH**. 259 m. One specimen.
St. 190. 24. iii. 27. Bismarck Strait, Palmer Archipelago, 64° 56′ 00″ S, 65° 35′ 00″ W. Gear **DLH** and **NRL**. 93–126 m. Twelve specimens.
St. WS 18. 26. xi. 26. 54° 07′ 00″ S, 36° 23′ 00″ W. Gear **OTL**. 160–330 m. Small fragment.

Stations 167 and 187 yielded only two small pieces of dead colonies. Inhabited colonies, dredged from station 190, consisted of twelve fragments, which were labelled in two bottles, owing to differences in the spines. The dimensions of entire colonies given by Ridewood (1907 *b*, p. 50), show that these are only broken bits of large colonies. The basal attachment is found in only one possibly entire colony.

The difference between two distinct types of colonies obtained from station 190 is shown in Pl. XXXIII, figs. 1 and 2. Careful study of their structure shows that the thickness of the coenoecium, the number of spines and the short branches on the colony cause these differences. Between these distinct forms there are colonies which are difficult to assign to either type. The existence of such intermediate forms proves that the external differences are the result of the amount of coenoecial material secreted by the animal. The coenoecium and spines are formed by the secretion of the coenoecial substance, laid down in thin lamellae. Increase in size is brought about by the deposition of lamellae over existing layers. Owing to differences in nutrition, and other causes, the amount of coenoecial substance secreted varies and this may account for differences which are observed between colonies dredged from different places.

In the absence of zooids in the colonies obtained from stations 167 and 187, the structure of the coenoecium is the only evidence that these colonies are modified forms of *C. hodgsoni*. The colour of the coenoecium, the thickness and length of spines and the disposition of short branches are sufficient differences to separate them from Forms A and B (see below).

Owing to subtle variations in the coenoecium of *C. hodgsoni* any attempt to give a comprehensive account of the structure may prove to be unsatisfactory. Generalization is rendered difficult by intermediate forms between the extreme types; but since the differences are only due to the amount of coenoecial substance secreted by the colony they do not affect the diagnostic character of the coenoecium as a whole.

The colony is formed of a main stem which has many lateral branches. The stem and branches are hollow and the continuous cavity opens externally by numerous ostia. The sides of the lateral branches and the edges of the ostia bear varying number of spines. These characters are constant in all the forms, and variations occur only in the disposition of the lateral branches, the spines, the number of ostia and the colour of the colony. Ridewood (1918 *a*, p. 51) defined two forms based on these variations, which he termed Forms A and B respectively. The present account follows the same line with a few new observations.

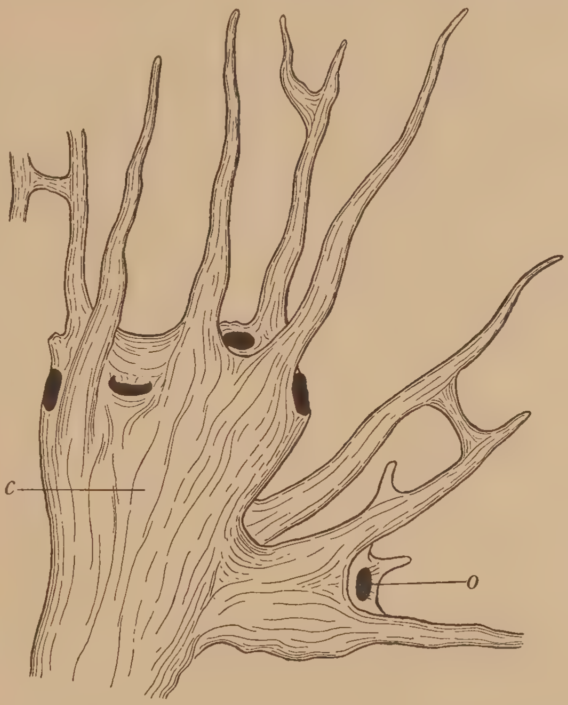

Fig. 1. *C. hodgsoni* showing the disposition in form A of ostia and spines on a short lateral branch. *o*, ostium; *c*, cavity of coenoecium.

Form A (Pl. XXXIII, fig. 1). This form is represented only by a few small pieces, mostly of a rich amber colour. The thickness of the coenoecium and width of the cavity varies between different parts. At the base, the cavity is small and circular with a diameter of 1·75 mm. and the coenoecium is about 1·5 mm. in thickness. Farther up, the cavity gradually widens and the walls become thinner. Towards the tips of the lateral branches the cavity widens still more and becomes oval in section. The lining of the cavity is smooth, but near the base of the colony there are stout bars extending at intervals across the cavity and fused at both ends with the lining. In one specimen a few pocket-like septa were found on the inner lining, near the base. Pocket-like septa are recorded for the first time, but they are not homologous with the irregular partitions and pockets found in *C. dodecalophus*.

At intervals along the sides of the stem and lateral branches are a number of short branches bearing funnel-shaped ostia. A short branch bears three, four or five spines and one or two ostia. The short branches enlarge by further branching of the spines and the bifurcation of the ostia. In one case as many as seven ostia and fourteen spine-tips have been counted on one small branch. The diameters of the ostia vary from 1·5 to 2·5 mm. and the number of marginal spines ranges from two to five (Fig. 1).

The short branches are not produced at regular intervals. On some branches they are wide apart, and on others closely set. On one branch seventeen short branches were counted in a 5 cm. length; while on another only nine were found in the same length.

The tips of the main branches also bear ostia which are identical with those already described. New ostia are formed by the growth of ridges between the spines. Ridewood (1918 *a*) has given a detailed account of their formation, to which I can add nothing.

The spines are long, tapering and may be simple or forked. The forking first appears as a knob of spine rudiment at some point on the side, very often near the tip of an old spine. It continues to grow in length by the deposition of lamellae. Some of the branches grow upwards, while others, developing horizontally, fuse with adjacent spines or with the spines of adjacent short branches.

Form B (Pl. XXXIII, fig. 2). The short branches are much larger and the spine longer and thicker than those of Form A. Broadly speaking it may be said that Form B is larger in every way than Form A. The two forms are distinguished by the spines and short branches; apart from these there is very little difference in the general structure of colonies. The cavity is crossed by a few horizontal bars in the basal region, but has no side pouches.

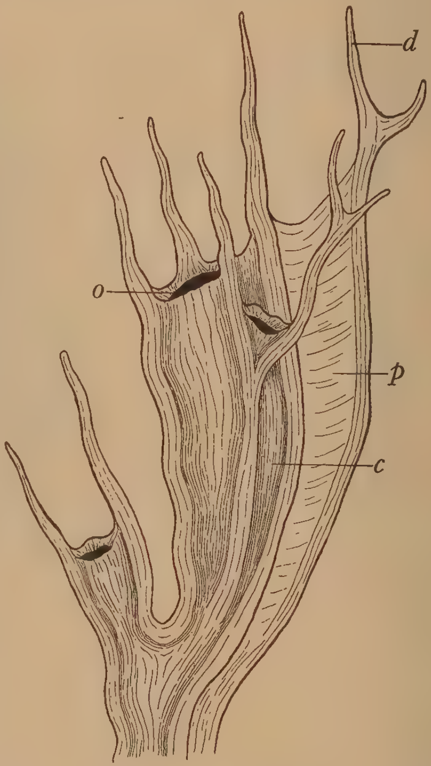

Fig. 2. *C. hodgsoni*. A short branch showing the relation of the spines to the ostium in Form B. *o*, ostium; *c*, cavity of coenoecium; *p*, plate of coenoecium connecting spine *d* with wall of coenoecial cavity.

The short branches of Form B are at least twice as long as those of Form A. Each branch has a main central ostium and one or two smaller ostia at the side, a little below the main one (Fig. 2). Typically the main ostium, which measures 3 mm. across the longer diameter, is surrounded by four long spines and leads into a funnel-shaped cavity. Two spines project obliquely upwards from the branch and are attached to its sides by a plate of coenoecial substance which spreads as a web between the spines and the side of the branch. Lower there is another small ostium which has two spines, one at each end of its long diameter.

The spines are thick and blunt but are fewer than those of Form A. While fourteen spine-tips were counted in an ordinary short branch of Form A, not more than eight or nine are found in Form B. They are only rarely forked. Many of the spines that are seen projecting freely from the surface of the coenoecium are embedded for a considerable proportion of their total length in the coenoecial wall. These embedded parts were at one time free spines, but were later covered by the growth of the coenoecium, and the support thus given was used as skeletal structure on which the tubes were lengthened. As the growing tubes thus closed round the basal parts of the spines, these continued to elongate by the deposition of coenoecial material at their tips, so that they kept a constant length.

The short branches are fewer than those of Form A. In one specimen, for a distance of 5 cm., there are only six short branches, and in another, for a distance of 6 cm., only eight short branches were counted.

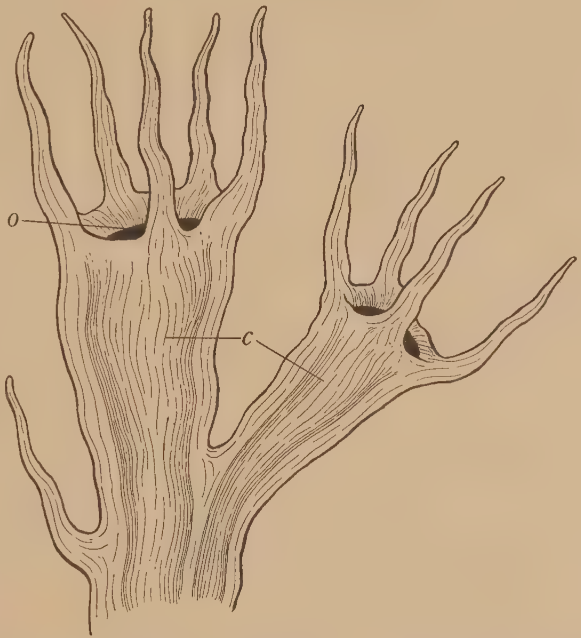

Fig. 3. *C. hodgsoni.* A short branch of the single specimen obtained from St. 167. *o*, ostium; *c*, cavity of coenoecium.

Besides the two distinct types of the species already described two specimens were obtained, one from station 167 and the other from station 187. Since both were dead colonies they cannot be definitely called new forms. Although the coenoecium shows a general structure greatly resembling that of *C. hodgsoni*, I do not venture to base my conclusion entirely on the structure of the coenoecium without examining the zooids. I shall therefore only describe the two pieces, and leave a definite identification to the time when inhabited colonies are obtained in sufficient quantity.

Pl. XXXIII, fig. 4 is a photograph of the specimen obtained from station 167, and Fig. 3 is a short branch of the same. The main stem produces along its sides a number of secondary branches, and one secondary branch is connected with the main stem by a lateral bridge. This bar suggests a resemblance to *C. dodecalophus*, but while the connecting bars of *C. dodecalophus* (M'Intosh, 1887, p. 4) are solid, the one in this form is traversed by the cavity of the secondary branch and main stem.

The main cavity is continuous through the colony and the coenoecial wall is 3 mm.

in thickness at the base. It is formed of two distinct layers which can easily be separated one from the other. The inner layer forms the smooth lining of the cavity and is occasionally beset with horizontal bars which run across the cavity. This dark reddish-brown layer is surrounded by a thicker outer layer of a lighter tint.

The main stem and secondary branches bear along their sides a number of short branches each of which carries a single ostium at its tip. The ostia are almost circular and each has four short spines at its edges. These spines, which are pointed, may be forked.

A unique feature of this colony is the dark reddish-brown colour of the coenoecium which by itself might serve for regarding this as a new form of *C. hodgsoni*.

The small specimen obtained from station 187 is represented in Pl. XXXIII, fig. 5. From such a fragment it is difficult to draw any conclusions about the entire colony. The coenoecium is yellowish white. It may perhaps be thought that the pale colour is due to disintegration after the zooids had died or left the colony; but the experiment of Ridewood (1918 *a*, p. 60) refutes this. In order to test the durability of the coenoecium he kept a piece of colony in distilled water partly exposed to air. At the end of two years there was no difference between this piece and the remainder, preserved in alcohol. The pale colour of the coenoecium is therefore the natural colour of the entire colony. Short lateral branches with ostia are borne along the sides. The ostia are like those of Forms A and B. Each short branch has three or more ostia which may be divided. The edges of the ostia bear four or more spines which are sometimes forked. The spines are not more than 1·5 cm. long and are blunt.

The internal anatomy of the zooids is treated in a separate section. Points of systematic importance are given here. A fairly extended zooid measures from 2·2 to 3·2 mm., and possesses ten or twelve arms. The stolon arises from the basal region of the body and carries two or four buds. The length of the stolon depends on the amount of contraction at the time of death. A fairly extended one measures up to 6 mm. Very often the zooids are found crowded together into certain parts of the cavity, and the stolons and buds are entangled in such a way that they cannot be easily separated.

The colour of the zooids and the number of arms present an important problem which has not been properly studied until now. Andersson (1907) stated that in *C. inaequatus* the males have twelve arms and females ten. But from the collections of the 'Terra Nova' Expedition Ridewood (1918 *a*, p. 64) showed that there is no great correlation between number of arms and sex. One difficulty of verifying this result is that in most zooids the gonads are immature so that their sex cannot be determined.

In the present collection I was able to distinguish: (*a*) colonies in which all the zooids are crimson-brown and bear six pairs of arms, (*b*) colonies in which all the zooids are pale brown and possess ten or occasionally eleven arms, (*c*) colonies in which both kinds of zooids are present, though the crimson-brown ones predominate. Sections of these two kinds show that the crimson-brown zooids are always females with well-developed paired ovaries, and that the pale brown zooids are males. Therefore some of the colonies are unisexual and others bisexual, although in these female zooids are the more numerous.

In his description of *C. inaequatus*, Andersson (1907) says that female zooids have ten arms and males twelve. This is contrary to my observations and may strengthen the claims of Andersson for regarding *C. inaequatus* as a distinct species. But since the classification of *Cephalodiscus* is based mainly on the structure of the coenoecium, the close resemblance between the coenoecium of *C. inaequatus* to that of *C. hodgsoni* makes the line of demarcation very faint.

Sub-genus **Idiothecia**

Cephalodiscus nigrescens, Lankester.

Lankester, 1905.
Ridewood, 1907 *b*, 1918 *a* and 1918 *b*.
Gravier, 1913.

Diagnosis. Colony massive, branching; maximum width of a single branch 5 to 9 mm., branches roughly cylindrical. Colour greyish, translucent. Ostia placed at the end of peristomial tubes, but in the main stems frequently sessile. Abaxial edge of peristome produced into a blunt lip. No spines. Each ostium leading into a tube which ends blindly in the middle of the branch. The length of the peristomial tube depends on the thickness of the branch. The lower part of the tube is curved downwards slightly and shut off by a septum, so that the zooids inhabit the upper region only. Width of the cavity of the peristomial tube 1·2 to 1·3 mm.; length 14 to 21 mm. Length of the zooid from free end of the body to tip of arms 4 to 6 mm. Preserved zooids blackish, with six or seven pairs of arms. Each arm with two longitudinal black bands running along the whole length of its axis. Arms without end-swellings. Male, female and hermaphrodite zooids occurring in the same colony.

Locality.

St. 190. 24. iii. 27. Bismarck Strait, Palmer Archipelago, 64° 56′ 00″ S, 65° 35′ 00″ W. Gear **DLH** and **NRL**. 93–126 m. Large quantities. Gear **DLH**. 315 m. One specimen.

It is interesting that *C. nigrescens* was dredged from the same station which also yielded a good collection of *C. hodgsoni*. Much material was dredged from the depth 93 to 126 m. and only one piece of a branch from a depth of 315 m. No differences in structure or colony formation were observed between specimens from the two depths.

Colonies of *C. nigrescens* are formed of branching cylindrical stems of varying thickness. The test[1] is gelatinous and almost transparent in the growing regions.

The older parts are greyish brown with a maximum transverse measurement of 30 mm. The minimum width of a branch is 5 to 9 mm. The ends of the branches are either blunt or tapering.

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[1] The continuous cavity found in *Demiothecia*, occupied in common by the zooids, is replaced by a number of small tubes in *Idiothecia*, each occupied by one zooid and its buds. These are embedded in a common mass of coenoecial substance. Because of this differentiation, Ridewood (1907 *b*, p. 21) introduced the term "Tube" for the individual cavities occupied by the zooids (instead of cavity) and "Test" for the common mass of coenoecial substance (instead of coenoecium).

The tubes in which the zooids live open at regular intervals on the surface of the colony. In the young branches the substance of the test is transparent enough to show the disposition of these tubes. In the older parts they are reddish brown and can easily be distinguished from the surrounding substance of the test. They run from the axial region of the branch obliquely upwards and are not more than 12 mm. long in the young growing points. They project 3 or 4 mm. from the surface, but as growth proceeds, more and more coenoecial substance is laid down in strata, filling the depressions and increasing the thickness of the test so that the ostia come to lie on the surface of the branch. Any further increase in thickness is accompanied by a corresponding increase in the length of the tubes, so that the ostia always open on the surface and the lips alone project.

A longitudinal section passing through the axis of an old stem shows the arrangement of the tubes clearly. Their width is almost constant (1·2 to 1·3 mm.) and they are embedded in the greyish brown mass of the test, forming the bulk of the colony. Near the ostium the cavity of the tube is wider, and the part remote from the ostium is closed. In the oldest regions, the tubes are 20 to 24 mm. long, but the lower part is closed by a septum so that the zooids occupy only the distal half.

The lips are triangular projections of the abaxial margin of the peristomial tube, but on some they are shifted slightly to the sides. They are 2 to 2·5 mm. long, and project at right angles to the surface. On older branches they are shorter and thicker.

Some adjacent branches are attached to each other by the secretion of coenoecial substance. In a few cases the tip of a branch of one colony is attached to the body of a branch of another colony. From this it seems possible to infer that whenever adjacent branches of colonies growing close together touch, they fuse, so that disturbing movements in the water may not injure the zooids.

Each tube is occupied by one zooid and its buds, which in the preserved condition are situated 4 or 5 mm. from the external opening. Owing to their dark colour they are clearly visible through the test. The zooids measure 3·5 to 4·5 mm. from base of body to tip of arms, and are deeply pigmented. The body of a full-grown zooid fits fairly closely in the tube.

The stolon, which is 1 to 1·4 mm. long, projects from the basal part of the body and ends in a knob on which the young buds grow. A fully formed zooid bears two to nine buds. The smallest buds are crowded round the tip and in the preserved condition they are very much contracted, with their stalks twisted about one another owing to the effect of the fixative. The buds at the tip of the stolon are the youngest ones. These have a very short body and proboscis. As the stalks lengthen during growth the buds are removed farther away from the parent stolon. When the mother zooid is freed from the tube, one or two buds are seen pressed to the side of the body, a few entangled among the arms, and rarely one or two projecting beyond the tip of the arms. Such a bud is still connected with the parent stolon by its own stalk, which has grown long enough to carry it to its present position.

The situation of the older buds suggests the possible mode of liberation. The adult zooid of *C. nigrescens* never completely leaves the tube. It moves forward towards the ostium and may even push its body out, but the stolon always remains fixed to some point on the inside of the tube, so that on the slightest danger the body is withdrawn into the tube (cf. "Observations on living zooids," Andersson, 1907). This habit makes the elongation of the stalk essential for the proper freeing of the buds. The buds when first formed are sessile. They develop slender stalks which rapidly elongate upwards, the buds remaining as thin flat plates. The lengthening of the stalks pushes the buds through the narrow space between the body of the mother and the wall of the tube, and, reaching beyond the arm-tips of the mother, the buds break away as free individuals.

Serial sections were cut of selected zooids from representative pieces of colonies, but no new observation that is worth recording has resulted. The blackish colour of the body is caused by a superficial layer of large brown cells. They occur in great abundance also on the dorsal wall of the proboscis.

The proboscis, which is attached by its dorsal part to the collar region, is oval with indented sides. It measures 1 to 1·2 mm. along the antero-posterior axis, and about 0·8 to 0·9 mm. from side to side. The curved red line runs horizontally between the indentations. The region just above and below the red line is lighter, the pigmentation being deepest on the anterior and posterior edges. The middle part of the ventral face of the proboscis is thick and stains deeper than the rest of the body. In longitudinal sections passing through the middle of the proboscis one or two narrow invaginations are found. These may be tracks through which the coenoecial substance formed by the glandular proboscis flows out.

There are usually seven pairs of arms, but zooids with six pairs are also found. They are devoid of end-swellings with refractive beads and possess two dark longitudinal bands along the axis. Towards the tips the two bands approach one another and fuse into one broad band.

In general, the internal structure of the zooid of *C. nigrescens* agrees with that of all other species. For systematic purposes the only noteworthy difference is the position of the heart and pericardium relative to the notochord. In *C. dodecalophus* the heart and pericardium are placed at the tip of the notochord, but in *C. nigrescens* the pericardial sac is attached to the notochord subterminally.

Sub-genus **Orthoecus**

Cephalodiscus densus, Andersson (Pl. XXXV, fig. 1).

Andersson, 1907.
Ridewood, 1918 *b*.
C. rarus (Andersson), Ridewood, 1918 *a*.

Diagnosis. Colony not branching, a bulky mass or cake, composed of closely set, vertically directed tubes of uniform diameter (1 to 1·2 m.), measuring up to 70 mm. in height. Colourless or pale brown. Longest tubes (which are found towards the centre of the colony) 60 to 70 mm.; those towards the edges, shorter. Ostia transverse and circular. Tubes ending blindly below, their basal parts held together by common coenoecial substance, which is very soft and spongy and sometimes encrusted with sand grains. Zooids greyish white, orange or brown. Length of a fairly extended zooid from tip of arms to base of body 4 to 7 mm., length from base of arms to end of body 2 to 4 mm. Arms, usually eight pairs, no end-swellings. Male, female and hermaphrodite zooids found in the same colony. Testis elongate and pyriform. Buds, six to twelve on each zooid.

LOCALITY.

St. 82. 20. vi. 26. 32° 42′ 00″ S, 2° 05′ 00″ W. Gear **N200**. 75 (–0) m. One specimen.

St. 190. 24. iii. 27. Bismarck Strait, Palmer Archipelago, 64° 56′ 00″ S, 65° 35′ 00″ W. Gear **NRL**. 126 m. Two specimens.

St. WS 82. 21. iii. 27. 54° 06′ 00″ S, 57° 46′ 00″ W. Gear **OTC**. 140–144 m. One specimen.

The coenoecium of the small piece obtained from station 82 is very much damaged but the zooids are in an excellent state of preservation. The two specimens (broken pieces of colonies) from station 190 are well preserved and the tubes undamaged (Pl. XXXIII, fig. 6). The common coenoecial substance and tubes of one of the specimens contain sand grains, fragments of shells and sponge spicules.

The colonies of *C. densus* are formed by closely set, vertically directed tubes which are held together in the basal region by common coenoecial substance. Since the present collection is formed only of fragmentary pieces, nothing definite can be said about the shape of entire colonies. As the tubes are closely set, and new tubes are formed only at the periphery, the colony increases in bulk laterally. If new tubes are formed uniformly all over, a large colony may have a flat cake-like appearance, but if growth on any one side is obstructed, the colony may have a more or less irregular outline. If this is proved to be the case, the shape of the colony can be regarded only as a secondary factor, depending upon the rapidity with which new tubes are added in any particular region and the presence or absence of obstruction near any part of the colony. On a plane substratum, the colony may extend equally on all sides and assume the perfect shape recorded by Ridewood.

The thickness of the wall of the tube varies. In the specimen obtained from station 82 the external diameter of the tube is 1·3 mm. and the internal diameter 1 mm. But the external diameter in the specimen obtained from station 190 is 1·6 mm., and the internal diameter is only slightly less, the tubular wall being very thin. The tube ends blindly below in the common coenoecial substance and at the upper free extremity opens by a transverse circular ostium devoid of any kind of lip-like outgrowth. They are slightly irregularly curved in the long axis, but there are a few straight tubes in the colony. The smooth inner lining of the tube is formed of thin rings. These are surrounded by an outer layer of irregular thickness. When a tube is dissected out in order to remove the zooids, the outer layer peels off easily, but the thin inner layer adheres closely to the visceral mass of the zooids, so that often it cannot be removed without damaging them.

Andersson (1907, p. 12) separates *C. densus* from *C. rarus* by the nature of the tubes.

He says that in *C. densus* the tubes are straight and that in *C. rarus* they are irregularly curved. While in *C. densus* the tubes are 6 to 7 cm. long and the coenoecial substance at the base free from sand particles, the tubes of *C. rarus* are only 4 to 5 cm. long and are distinguished by the presence of sand grains in the coenoecial substance. But Ridewood (1918 *a*, p. 40) has shown that these distinctions are the result of variations which do not affect either the structure of the colony or the characters of the zooid. The colony when first formed consists only of a few tubes, which, being unimpeded by anything in the immediate vicinity, are irregular and even straggling. As the zooids multiply, the tubes become more and more closely set and older tubes become longer and straighter, consequently after a study of complete series of gradations between *C. rarus* and *C. densus*, he concluded that *C. rarus* is synonymous with *C. densus*. Even the differences in thickness of the epidermis of the axis of the arms are such as might occur within the same species.

Nothing more need be said to emphasize Ridewood's conclusions. The two specimens obtained from station 190 both possess tubes which are mostly curved. The older tubes are 5 to 6 cm. long and their distal parts straight. In one colony there are a few stray sand grains embedded in the coenoecial substance, but in the other the sand grains and diatoms are numerous.

It may be added that the occurrence of sand grains in the common coenoecial substance is not constant, resulting from selection by the zooids, but depends rather on the immediate surroundings. If the colony grows in unsheltered spots or at the base of submarine rocks the particles which constantly rain from the upper regions of the sea or drop occasionally from the sides of the rocks may fall on the colony and become embedded in the common coenoecial substance. The quantity of sand grains on the colony will depend on the intensity of the rain of particles from above, so that it is possible to find colonies free from sand grains, or with only a few stray particles, growing in the sheltered places. This is supported by the different colonies of the present collection in which the quantity of sand grains, included in the common coenoecial substance, varies markedly.

Each tube is occupied by one zooid and its buds. In the preserved condition the upper tip of the zooid is situated about 7 to 9 mm. below the ostium. The zooids are pale white, but the arms are brownish. The body is straight, longer than that of other species and measures 4 to 10 mm. from base of body to tip of arms. When a zooid is viewed under a lens, two white elliptical patches can be seen slightly bulging out on each side of the pharynx. They arise from the base of the collar region between the opening of the rectum and the pharynx. These are the gonads, which are conspicuous in this species. All the zooids which have been examined in section are hermaphrodite, but both Ridewood and Andersson have observed male and female zooids, with paired testes or ovaries. Ova occupy the upper part of the ovary, the lower part being filled with yolk granules. Sometimes a few eggs are found in the basal part of the tubes. The testis is a thick-walled elliptical tubular organ. The sperm are formed in the thick wall and liberated into the central space from which they pass out through the short vas deferens which opens between the rectum and the pharynx.

Illustrations of sagittal and transverse sections passing through the gill region are given in Plate XXXVI, figs. 3–6. The external gill slit (*eg*) opens into a cavity (*gc*), placed between the body wall and the wall of the pharynx. The wall of this gill cavity is formed of vacuolated tissue, called pleurochord. In other species there is a deep groove running along the entire length of the pleurochords on either side of the pharynx, which starts from the gill slit, and probably the respiratory water traverses these grooves. The gill cavity found in this species may have originated by the enlargement of the groove and the fusion of the lips, resulting in the formation of a tubular space (*gc*) between the pharynx and the body wall, opening on the one side into the external gill slit, and on the other into the pharynx by a narrow slit, which for convenience will be termed the internal gill opening (*ig*). Whereas in other species water passes directly from the pharynx through the gill slit, the intervention of this cavity makes the passage of the respiratory water more complicated. Water flows from the pharynx through the internal gill opening into the gill cavity whence it passes out through the external gill slit.

The proboscis, which is oval with indented sides, is small compared to the zooid. It is 1·1 mm. long and 0·9 mm. broad. The red line runs near the posterior margin.

There are always eight pairs of arms without end swellings. The pinnules on the basal parts are 0·4 to 0·5 mm. long. The dorsal wall of the arm has a thick layer of vacuolated cells each of which encloses a refractive bead similar to those in the end-swellings of *C. dodecalophus* and *C. hodgsoni*. This layer curves over the tip of the arm so that a few refractive beads occur in the tip also. Thus although end-swellings are not found, there are refractive beads in the tips. The arms on the extreme right and left sides are directed downwards on either side of the mouth in the preserved condition. The longest arms measure 1·7 mm., but those towards the sides are shorter.

The stolon varies considerably in length and thickness. In some it is thin and about 25 mm. long, and in others thick and short, with a brownish tint on one side. The difference in length of the stolon is probably due to contraction when the zooids were fixed, but even in the contracted state it is much longer than the stolon of other species[1].

Cephalodiscus fumosus, n.sp. (Pl. XXXIV, fig. 1).

DIAGNOSIS. Colony unbranched, in the form of a brittle arenaceous cake, measuring 90 mm. across and 16 mm. high and consisting of evenly distributed (5 to 7 mm. apart) vertically disposed tubes of uniform diameter. Tubes pale brown, buried in the common mass, which is formed of a dense agglutination of minute sand grains. Each ostium produced on one side into a short thick triangular lip, which can fold over like an operculum. Those in the middle of the colony 14 mm. long, those near the edge shorter. Width of the tube near the ostium 1·4 mm. Length of fairly extended zooid from tip of arms to base of body 3·2 mm., length of arms 1·2 mm., width of body 1 mm. Colour of preserved zooids—dorsal side of body and stolon light brown, ventral side brownish white. Proboscis with dark brown upper and lower edges. Usually eight pairs of arms, each with two black longitudinal bands running along the entire length as in *C. nigrescens*. No end-swellings with refractive beads. Female and hermaphrodite zooids found in the same colony. Up to ten buds on each zooid. The colony has a smoky grey colour which suggested the specific name.

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[1] Sir Sidney Harmer, when reading through this paper, suggested that during life the length of the stolon varies greatly from time to time, but that this point was not sufficiently appreciated by earlier workers who very often cited the length of the stolon of the preserved zooid as a diagnostic character of the species of *Cephalodiscus*.

LOCALITY.

St. 170. 23. ii. 27. Off Cape Bowles, Clarence Island, 61° 25′ 30″ S, 53° 46′ 00″ W. Gear **DLH**. 342 m. One entire colony and a broken piece.

The material of this species consists of a single large colony, and another broken piece from which the zooids were removed and separately preserved. Sections were made of the preserved zooids and the large colony was used only for purposes of general description.

The large colony is flat and semicircular in shape, but since the diametrical edge is irregular and broken, it may be assumed that an entire colony is oval or circular with a convex upper surface, thick in the centre and thin towards the edge (Pl. XXXIV, fig. 1).

In most other species of *Cephalodiscus* the colony is formed by the secretion of coenoecial substance, the inclusion of sand grains being only a secondary factor depending on the nature of the surroundings. In *C. solidus* (Ridewood, 1918 *b*, p. 18) large quantities of sand grains, sponge spicules and diatoms are found in the common coenoecial substance of some of the colonies, while others are leathery and non-arenaceous. In *C. agglutinans* foreign particles are included in the soft substance, but some parts of the branches may be devoid of sand grains. In *C. fumosus* the entire mass of the colony is formed of a dense agglutination of sand grains. The particles are very minute and of uniform size and being closely packed together give a homogeneous appearance to the colony. The coenoecial substance is sparsely secreted and is used only for making the thin-walled tubes and binding the sand grains together. Since the bulk of the colony is formed of such a consolidation of sand particles, it is very brittle and easily breaks to pieces when removed from its place of attachment. The basal part has an irregular surface, because the colony grows on a sandy bottom, to which it is fixed by the secretion of a thin layer of coenoecial substance. When the colony is dislodged large particles of the substratum firmly attached to the basal surface come with it. It seems clear from the nature of the particles that they must definitely be selected by the zooids for the construction of the coenoecium, in the same way as certain Foraminifera construct their arenaceous shells. Ridewood (1918 *a*, p. 41) observed that the inclusion of sand grains or foreign particles is not a constant character of any species of *Cephalodiscus*, and that it may be purely local, depending only on the nature of the sea bottom where the zooids first settled down. "It is quite possible that in more rocky parts of the ocean floor the zooids of the species might build up a perfectly clear and transparent coenoecium." Though this is applicable to most species of *Cephalodiscus*, it cannot be said that the arenaceous nature of the colony of *C. fumosus* depends on chance. If the inclusion of sand grains is regarded as a regular habit of this species, a rocky substratum would be unfavourable for growth and it is possible that the first zooids of the colony always selected a loose sandy bottom. An examination of the coenoecium supports this opinion, but it cannot be definitely established until the habits of the species are known.

The tubes are uniformly distributed 5 to 7 mm. apart. They are thin-walled and vertical. The entire length of the tube lies within the mass of the colony, so that the ostium opens on the surface. On one side the margin of the ostium is prolonged into a vertical triangular lip covered with an outer layer of sand grains. It is capable of folding over the ostium, so that when the lip is closed the ostium cannot be distinguished from the rest of the surface. At the ostium, the tube is 1·4 mm. across, but it becomes slightly narrower at the blind end. The longest tubes in the central region are 14 mm. long. Towards the edge they become shorter and the shortest ones, close to the margin, are inclined outwards.

Each tube is occupied by one zooid and its buds. In the preserved condition the upper tip of the zooid is situated nearly 4 mm. below the ostium. The dorsal part of the body is dark brown, the ventral part and the sides are brownish white. The dark brown colour extends along the entire length of the dorsal part of the stolon as a brown band from the base of the arms to the tip of the stolon.

In the females the ovaries are seen on either side of the pharynx as two conspicuous white masses, which are directed obliquely ventrally. Hermaphrodite zooids could also be distinguished, for the white mass is only on one side; the other side being occupied by the testis, which is not a conspicuous structure. This difference between female zooids and hermaphrodites can be observed only when the gonads are well developed. The ovary is an elliptical organ with seven or eight heavily yolked ova. The short oviduct opens at the base of the collar region between the pharynx and the rectum, just below the lower end of the main nerve mass.

Between the gonads and the rectum there is a small invagination of the ectoderm which dilates into a flask-shaped cavity. This is lined with ectodermal cells and opens through the narrow neck. It is difficult to account for the function of this cavity since it is found to be almost empty. Its position near the ovary and the proximity of its opening to the oviduct suggests that it is a kind of brood-pouch in which the developing ova are received. But since no such structure is found in any other species, this view must be accepted with caution.

The body is slightly curved like that of *C. hodgsoni*. The pharynx runs slantwise, and near the middle of the body opens into the stomach. The ventral wall of the stomach is very much thicker than the dorsal and contains numerous closely set transverse folds. The intestine is a long narrow tract which dilates into a spacious rectum. The epithelial lining of the rectum is also thrown into long narrow folds (Pl. XXXVI, fig. 1).

The stolon originates from the region where the pharynx opens into the stomach. It is directed downwards following the curve of the body. A thin connection keeps the stolon attached to the body. From the base it continues downwards as the free stolon, which is 4·5 mm. long and ends in a knob.

The proboscis is almost circular. It is of a pale brownish colour, but the edges are dark brown like the dorsal side of the trunk. The ventral glandular wall of the proboscis is not as thick as in *C. hodgsoni* or *C. nigrescens*, and this accords with the habit of secreting a limited quantity of coenoecial substance. In the middle of the ventral wall of the proboscis there is a thin short finger-like protuberance which is directed upwards. Small sand grains might be held between this protuberance and the proboscis and thus carried to the edge of the colony, to be there cemented on to the surface.

There are usually eight pairs of arms which are conspicuous by their dark bands and long pinnules. *C. solidus* also has eight pairs of arms, but they are devoid of the black pigmented bands which are seen only in *C. nigrescens* and this species. The pigmented bands start from the base of the arm and run on each side. Near the tip they converge and fuse into a single broad band. The tip has the appearance of a rounded knob without pinnules. But this knob-like termination cannot be compared with the end-swellings with refractive beads found in *C. hodgsoni* and *C. dodecalophus*. The arms measure 1·2 mm. in length and the pinnules are 0·5 to 0·6 mm. long.

Though the zooids of *C. solidus* and *C. fumosus* are of the same size and possess the same number of arms, the latter can always be distinguished by the presence of the dark bands in the arms. The zooids of *C. solidus* are black in the preserved condition; thus the colour of the preserved zooid of *C. fumosus* will also serve to separate the two species.

Sub-genus **Acoelothecia**, sub-gen. nov.

Diagnosis. Colony small or large, and branching; formed of a meshwork of bars and spines without any definite coenoecial cavities. Spaces between the meshwork irregular and continuous and occupied in common by the zooids and their buds.

Cephalodiscus kempi, n.sp. (Pl. XXXIV, figs. 2–6).

Diagnosis. Colony small and tuft-like or large and branching. The tuft-like colonies are about 3·5 to 4·5 cm. from base to tip of spines. The branching forms sometimes reach a length of 10 cm. and in thickest parts are 3·5 cm. across. The inhabited parts of the colonies are formed of an elaborate meshwork of cross-bars between spines. The coenoecium is devoid of definite tubes such as those found in the other three sub-genera, whence the name *Acoelothecia* for the new sub-genus. Spines with varying length and thickness are found all along the sides of the branches. No definite ostia are present. Spaces between the surface meshwork of bars and spines act as temporary outlets. Colour of the colony from light brown to reddish brown, older parts always of a deeper tint. Length of a fairly extended zooid from base of body to tip of arms 1·8 to 2 mm.; length from base of arms to base of body 1·1 mm.; width of body 0·9 to 1 mm. Colour of preserved zooids amber. Arms usually five pairs, with end-swellings and refractive beads. Male, female and hermaphrodite zooids found in the same colony.

LOCALITY.

St. 152. 17. i. 27. 53° 51′ 30″ S, 36° 18′ 30″ W. Gear **DLH**. 245 m. Two specimens.

St. 156. 20. i. 27. 53° 51′ 00″ S, 36° 21′ 30″ W. Gear **DLH**. 200 to 236 m. One specimen.

St. 158. 21. i. 27. 53° 48′ 30″ S, 35° 57′ 00″ W. Gear **DLH**. 401 to 411 m. Large collection.

St. WS 71. 23. ii. 27. 6 miles N 60° E of Cape Pembroke Light, East Falkland Islands. 51° 38′ 00″ S, 57° 32′ 30″ W. Gear **OTC**. 82–80 m. Three specimens.

St. WS 72. 5. iii. 27. 51° 07′ 00″ S, 57° 34′ 00″ W. Gear **OTC**. 95 m. One specimen.

St. WS 84. 24. iii. 27. 7½ miles S 9° W of Sea Lion Island, East Falkland Islands. From 52° 33′ 00″ S, 59° 08′ 00″ W to 52° 34′ 30″ S, 59° 11′ 00″ W. Gear **OTC**. 75–74 m. Two specimens.

St. WS 85. 25. iii. 27. 8 miles S 66° E of Lively Island, East Falkland Islands. From 52° 09′ 00″ S, 58° 14′ 00″ W to 52° 08′ 00″ S, 58° 09′ 00″ W. Gear **OTC**. 79 m. Small fragments.

St. WS 97. 18. iv. 27. 49° 00′ 30″ S, 61° 58′ 00″ W. Gear **OTC**. 146–145 m. Large collection.

St. WS 211. 29. v. 28. 50° 17′ 00″ S, 60° 06′ 00″ W. Gear **OTC**. 161–174 m. Four specimens.

St. WS 216. 1. vi. 28. 47° 37′ 00″ S, 60° 50′ 00″ W. Gear **N7–T**. 219–133 m. Seven specimens.

From stations 158, WS 97, and WS 211 a considerable quantity of material was obtained. The material from station 158 consisted of small tuft-like colonies with radiating spines. The yield from stations 152 and 156, WS 71, WS 84, WS 97, WS 211, WS 216 consisted of long cylindrical branching colonies.

For the sake of convenience the short tuft-like colonies obtained from station 158 will be called Form A and the branching cylindrical form Form B. Although the habit of growth of the two forms is quite distinct the structure of the coenoecium and zooids is the same in both forms.

Form A. Most of the material was collected at station 158, from a depth 401 to 411 m. Small pieces were obtained from stations 152 and 156 at depths of 245 m. and 200 to 236 m. respectively. Since variation in size and structure is not met with, this form can be regarded as a distinct type of the species. The coenoecium in the preserved condition is light brown. The colony consists of a basal region of thick bars and spines forming a meshwork from which spines radiate on all sides except basally. The spines are thick, straight and tapering and measure 12 to 17 mm. They may be forked or branched. The origin and growth of spines are the same as in *C. hodgsoni*, that is, by deposition of coenoecial substance locally in the form of lamellae. A section of the spine shows two distinct regions. A transparent core of thin consistency surrounded by a firm, reddish brown, outer layer formed by a number of close lamellae.

A few colonies are slightly larger than the rest and have longer spines with pointed tips, though generally the spines measure 1·2 to 2·3 cm. and possess blunt or pointed tips. They are straight except for slight occasional curvature of the distal part of the spine by preservation.

When lamellae are deposited on the spine they may enclose any particles which are adhering to the surface of the older layer. Masses of sand grains, enclosed between layers of lamellae, appear like nodules on the side. In one instance a slender branch of a polyzoan colony was attached to the tip of the spine and had been almost enclosed by coenoecium.

The structure of the coenoecium of this species is such that it cannot be included in any of the three sub-genera previously recognized. The absence of a definite cavity forming tubular spaces individually or occupied in common by the zooids is unique. The spaces between the bars and spines on the surface of the meshwork are the openings through which the zooids come out and are not homologous with the ostia of other species, being only temporary outlets, which become part of the internal meshwork when new bars are formed above the existing ones.

Most of the colonies are attached to calcareous tubes of Polyzoa[1]. Some colonies are attached to the tips of these tubes, while in others they are horizontally embedded in the basal region, surrounded by a thin layer of coenoecial substance.

The sexual development of *Cephalodiscus* has not been thoroughly worked out. Harmer (1905, p. 102) described the embryonic stages of *C. gracilis* and *C. levinseni*, and Gilchrist (1917) gave an account of the larvae of *C. gilchristi*, but nothing definite is known about the metamorphosis and habits of the later stages of the larvae, as they were not studied in the living condition. In spite of this ignorance, we may assume that at the end of the free-swimming stage the larvae of *C. kempi* settle down on some suitably firm support, such as the calcareous tubes of Polyzoa, and secrete a thin layer of coenoecial substance which envelops part or whole of the supporting object.

Rudiments of spines are laid down on the surface of this envelope which project at various angles. As the spines increase in length, lateral bars are formed, which grow at right angles to the axis and fuse with adjacent spines. A complicated meshwork is thus produced by the formation of four or five cross-bars between each adjacent pair. By the additional deposition of coenoecial substance the lateral bars and spines increase in thickness, the angles become smooth and curved so that the original rectangular spaces become circular or ovoid. As the zooids increase in number and more space is required, new lateral bars are formed above, but the colonies do not grow beyond the tuft-like form.

Two growing colonies have been found attached to flat surfaces (one to the mantle of an Ascidian, and the other to a broken piece of Lamellibranch shell). In both of these, a flat, plate-like secretion was first formed. Colonies were also attached to fragments of sponges. Whatever the object to which the colony is attached, a layer of coenoecium is spread on the surface of the object, which as growth proceeds becomes partly or wholly enclosed.

Form B. This form is represented by material obtained from stations WS 71, WS 75, WS 84, WS 88, WS 97, WS 211 and WS 216. Stations WS 97 and WS 211 gave most of the collection, while from each of the other stations only one or two pieces were obtained.

Colonies are formed of massive cylindrical branching stems with a close array of spines along the sides. The length, thickness and nature of the spines depend on their position. In the basal regions the spines are long, stiff, thick and tapering, while towards the tips they are slender, shorter and very pliable.

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[1] "The Polyzoon which is associated with *C. kempi* is *Ogivalia elegans*, the *Vincularia elegans* of D'Orbigny, a species which is abundant in the 'Discovery' collections. This is a branching form with brittle branches. It seems not unlikely that the *Cephalodiscus* was growing on it and that the dredge merely broke off the tips of the branches." *Letter from Sir Sidney Harmer.*

The main stems are 3·7 cm. across in the thickest parts, but the width of the apical regions is not more than 1 to 1·8 cm. The older parts of the coenoecium are dark reddish brown and very opaque, so that the zooids inside cannot be seen, even by strong transmitted light. Nearer the tip, the dark mass of zooids can be seen distinctly through the light brown semi-transparent coenoecium. Usually the main stem grows vertically, producing secondary branches from its sides. A single stem 8 cm. long may bear as many as four to six branches. Branches are produced on all sides of the stem, but if the main stem is horizontal they are found only on the upper side. Entangled among the branches arenaceous tubes of Polychaetes, calcareous branches of Polyzoa, Ostracods and small Ophiurids are often found. Big sand particles and masses of mud are also deposited locally.

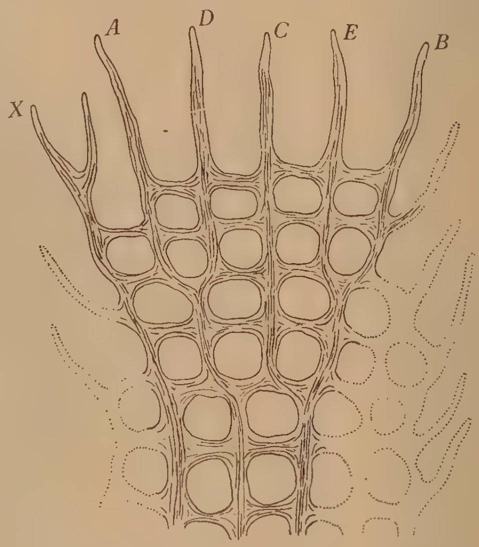

Fig. 4. *C. kempi*. Structure of the meshwork.

The colonies are a meshwork of bars and spines constructed as in Form A, but more elaborately, due to the greater length and thickness of the colonies. The spines of the tip of the branch are directed upwards so that the growth of the spines, accompanied by the formation of lateral bars between them, increases the length of the branch, while the production of lateral bars between the obliquely directed spines on the sides increases its thickness.

Although the meshwork is very distinct in the apical regions, the bars and spines lose their identity below by the addition of coenoecial substance around them. As in Form A, spaces in the surface meshwork form the openings for the zooids.

A hand-cut longitudinal section, from the interspaces of which the zooids are carefully washed out, shows the structure of the coenoecium given in Fig. 4. Spines *A* and *B* grow in opposite directions from the axial part of the branch. A lateral bar between them at the base results in the formation of a closed mesh which is at first rectangular. Since these two spines diverge, if a second bar is formed between them above the first one, the space enclosed would be much larger than the first one, so in the middle of the first bar the rudiment of a new spine is laid down, which grows up as spine *C*. Between *A* and *C* and *C* and *B* two bars are formed simultaneously, thus enclosing two spaces which are of almost the same size as the one below. As the spine *C* continues to increase in length one or two more bars may be formed between *A* and *C* and *C* and *B*, without appreciably increasing the size of the spaces enclosed. Now the spines *D* and *E* are produced. These may be formed in the same way as spine *C* or may arise as branches from the side of *A* or *B*; but whatever the origin they serve the same purpose as spine *C*.

When these spines elongate, bars are formed between *A* and *D*, *D* and *C*, *C* and *E*, *E* and *B*. These intermediate spines limit the spaces in the meshwork and also increase the number of these spaces in almost geometrical ratio. Between diverging pairs of spines lateral bars are formed on this system, but when two spines run parallel to one another, as *A* and *X* do, a number of bars may be formed between them without intermediate spines. This meshwork is the inhabited part of the colony, beyond which the spines project.

The spaces between the bars on the surface form the openings for the zooids, but as the spines increase in length and new bars are developed above the older ones, the former openings become part of the internal meshwork.

In some branches the upper half is slender and pliable; this represents the growing part of the colony. When first formed the coenoecium is almost transparent and the spines are short and slender, but later by the successive deposition of coenoecial substance, the internal meshwork becomes thicker, and the spines stiff and straight. Between the fully developed colonies and the newly formed semi-transparent pliable pieces, branches representing different stages of growth are found. The differences between them consist mainly in the thickness of the branch, the length and thickness of the spines, and the colour of the coenoecium.

The zooids are small and measure 1·8 to 2 mm. from tip of arms to base of body. There are always five pairs of arms which are 0·9 to 1 mm. long and possess end-swellings with refractive beads. The stolon which is 1·3 to 1·7 mm. long originates from the base of the trunk and carries two to five buds. The rest of the anatomy agrees with that of *C. dodecalophus*.

INTERNAL ANATOMY

ORIENTATION

Two opinions are held about the orientation of the zooid. Ridewood considers the long axis of the body as longitudinal, while Harmer (1905, p. 23) regards this as transverse. The reason advanced for this view is that a section of the adult zooid passing through the collar region and proboscis at right angles to the long axis of the body shows all the five coelomic cavities like a frontal longitudinal section of *Balanoglossus*. Considering the U-shaped alimentary canal, the positions of the proboscis and the anal opening, this seems very acceptable. But with the lack of adequate knowledge of the development this opinion has at least one difficulty; during the development of the bud, before the arms are formed, the coelomic cavities are arranged in the long axis, so that a section passing medianly through the long axis shows the same arrangement of the coelomic cavities (Fig. 6) as a longitudinal section of *Balanoglossus*. At a later stage, when the arms are developed, the proboscis shifts forward and the coelomic cavities take up the new positions seen in the adult. Although the condition in the young bud is not regarded as the basis for correct orientation, it has been found convenient to adopt Ridewood's orientation, so that in the following account the long axis of the body is regarded as longitudinal (Fig. 5).

The internal anatomy of *Cephalodiscus* has been worked out very thoroughly by Harmer (1905) and Andersson (1907). From sections of the zooids of different species of the present collection it has been possible to verify these results. The following account does not attempt to give a complete description of all parts, but only deals with those organs and systems about which new observations have been made.

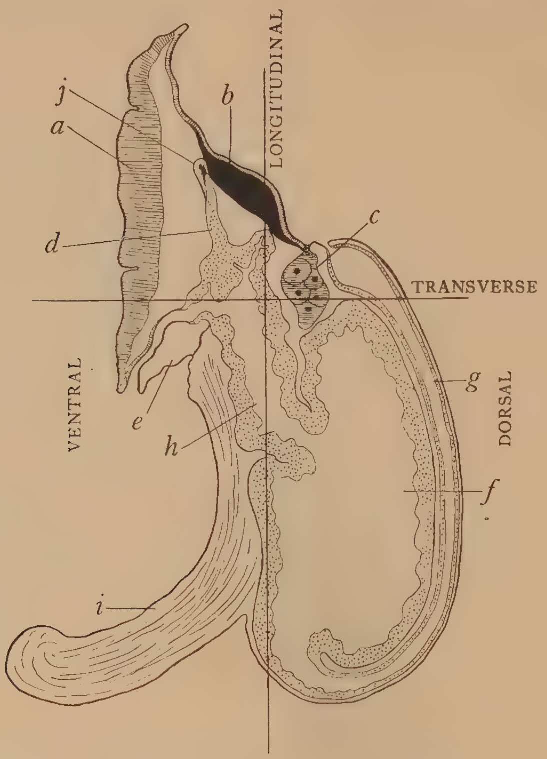

Fig. 5. Orientation of the zooid. *a*, proboscis; *b*, central nervous system; *c*, gonad; *d*, notochord; *e*, post-oral lamella; *f*, stomach; *g*, intestine; *h*, pharynx; *i*, stolon; *j*, heart and pericardium.

PROBOSCIS

The proboscis of *Cephalodiscus* varies in size and shape, as will have been seen in the systematic accounts. The discoidal part of the proboscis is attached to the body by a very short neck, which is always capable of a little extension. That this gives the disc great mobility is clear from the diverse positions of the proboscis in the preserved individuals. Observations made on the living zooids show that they come out of the coenoecium and creep on the surface of the colony, with the disc acting as a sucker. This was first recorded by Andersson (1907, p. 59) and confirmed by the observations of Dr Stanley Kemp during the present expedition. The disc is flattened dorso-ventrally.

The ventral wall is formed of elongated gland cells, and in the thickest part, at the base of the gland cells, there is a thin transparent layer, which looks like nerve tissue. The ventral wall of the anterior lobe of the proboscis is composed of a thin layer of epidermal cells, basement membrane, and coelomic epithelium, but in *C. densus* this region is comparatively thick and the epidermal cells have vacuoles like the refringent vesicles in the end-bulbs of *C. dodecalophus* (Pl. XXXVI, fig. 2). Behind the attachment of the proboscis to the collar, the dorsal and ventral walls approach each other, diminishing the proboscis cavity. Ultimately by the apposition of the two walls a thin lobe is formed, the posterior lobe of the proboscis, which functions as the roof of the passage into the mouth. The point where the two walls touch is the posterior boundary of the glandular part of the ventral wall, which is invariably marked by a line of red pigment, extending transversely from edge to edge.

It is difficult to explain the functional significance of this red line. It is surrounded by a group of minute nuclei and lightly stained large protoplasmic cells which can be distinguished easily from the glandular cells of the ventral wall. A similar patch of pigment occurs in the oviduct and M'Intosh (1887) suggested that the pigmented oviduct was a phosphorescent organ. Harmer (1905, p. 27) assigns to it a sensory function, though according to him the nerve supply to these regions seemed inadequate for this purpose. In the account of the nervous system it will be seen that there is a distinct nerve originating from the back of the main ganglion which runs to the oviduct, and that the nerve plexus at the base of the glandular region of the ventral wall of the proboscis does not extend beyond the red line. Although no distinct nerve connection with the red line is visible, the nerve plexus may end in the pigmented line by breaking up into very minute branches. The distinct nerve tract in the oviduct suggests that a similar connection exists in the pigmented line of the proboscis, and this definite relation to the nervous system confirms the suggestion of Harmer that the red pigment has a sensory function. This is emphasized by the occurrence of the red line in all known species, where it is prominent from very early stages in the development of the bud.

The proboscis cavity is traversed by thin strands of protoplasmic fibres and opens externally by two pores, the proboscis pores, which are on either side of the pericardium above the end of the anterior horns of the collar cavities.

COLLAR CAVITIES

The two collar cavities together form a ring encircling the pharynx. Dorsally the cavities are large and are separated into the right and left collar cavities by the dorsal coelomic mesentery. They descend downwards and extend into the post-oral lamella, where the two cavities are continuous; there is no ventral coelomic mesentery. The collar cavities open by the right and left collar pores, on either side of the pharynx, at the base of the post-oral lamella, just above the gills. The collar pores are thick-walled ciliated openings which lead by short canals into their respective collar cavities and control the water currents to maintain the turgidity of the collar and arms.

The arms are situated on the dorsal side of the collar. Each arm is a hollow tubular axis which may have an end-swelling (e.g. *C. hodgsoni* and *C. kempi*). The ectodermal cells of the end-swelling are vacuolated and contain refractive beads. In *C. nigrescens* and *C. fumosus* end-swellings are absent, but in *C. densus* and *C. sibogae*, although there are no end-swellings of the type described by Cole (1900, p. 256), refractive beads are found the whole length of the dorsal side of the arms. Sections of *C. densus* stained in Mallory show the vesicles and refractive beads very clearly (Pl. XXXVI, fig. 2). Some of the beads are stained blue and others red. They are ovoid or elliptical homogeneous bodies and normally are in the middle of the vacuolated spaces of the ectodermal cells. Some of these beads are sometimes found partly protruding from the surface of the cells.

M'Intosh (1887, p. 11), who first observed the refractive beads in the end-swellings of *C. dodecalophus*, described them as glandular. Masterman (1898 *b*, p. 344) suggested that they were crystalline refractive lenses, and drew the inference that these organs are rudimentary monostichous compound eyes similar in structure to the branchial organs found in sedentary Annelids. Later he discarded this view, and Cole (1900, p. 356) thought them rhabdite-producing organs. The greatest distribution of these refractive beads occurs in *C. densus* and *C. sibogae*; in others they are restricted either to the swollen tips of the arms or completely absent. The refractive beads therefore cannot have any general function, but serve more or less a specific purpose which at present is not understood.

The arms grow from the dorsal wall of the collar on either side of the central nervous system, and the collar coelom continues to the tip of each arm and into the pinnules on each side; the whole system thus recalls the water-vascular system and tube feet of Echinoderms. On the ventral side of the arm there is a longitudinal groove, termed the food groove. The movements of the pinnules convey food particles into the groove along which the particles move to the base of the arms. The food grooves of each side of the body open into a space between the posterior lobe of the proboscis and the ridge on the anterior margin of the collar. These together form an efficient tract for food particles to the mouth.

ORGANS OF THE TRUNK

The greater part of the trunk is occupied by the alimentary canal. The pharynx is a thick-walled chamber which in nearly all species extends half-way down the body and opens by an obliquely directed narrow oesophagus into the large stomach; this, on its postero-ventral side, in turn leads into the intestine. The intestine is a narrow tube which forms a loop and running upwards between the stomach and dorsal body wall opens into a large rectum. The anus is on the dorsal side just below the collar, at the base of the central nervous system. The gill slit on each side opens into the pharynx laterally at the base of the post-oral lamella, below the collar pores. The wall of the gill slits is formed of vacuolated cells. Transverse sections of the gill region show that the vacuolated cells in the roof of the gill slit do not extend to the extreme front end of the pharynx as described by Masterman (1898 *b*, p. 353), but that the floor of the gill slit continues backwards on each side of the pharynx as a band of vacuolated cells with a deep internal groove communicating with the cavity of the pharynx. The insertion of these lateral bands, the pleurochords, divides the wall of the pharynx more or less completely into four distinct regions, two lateral, a mid-dorsal and a mid-ventral. The two lateral regions are formed of the bands of vacuolated cells, and the mid-dorsal and mid-ventral walls of ordinary cells of the pharynx. The groove on the inner side of the pleurochords is deep and conspicuous in *C. hodgsoni*, and, as already mentioned, in *C. densus* a tubular space completely lined with vacuolated cells lies between the external gill opening and a cavity of the pharynx. This has been termed the gill cavity, and its opening into the pharynx the internal gill slit. The respiratory water passes through the gill cavity before it finds outlet through the external gill slit. This gill cavity could have been formed only by the fusion of the lips of the groove in the pleurochords. In other species where the lips of the groove stand apart, the respiratory water probably traverses the groove before passing through the gill slit. Assuming this to be so, it is clear that the pleurochords and the grooves play a definite part in respiration. Further, the pharyngeal blood vessels lead to the vacuolated region of the roof of the gill slit, but the mode of exchange of gases still remains a problem.

A rod-shaped structure with a narrow lumen projects upwards from the dorsal wall of the anterior diverticulum of the pharynx. This organ has been variously termed by different writers. Harmer (1887, p. 40) compared it with the notochord of *Balanoglossus*. Later, Willey (1902) described it as the stomatochord, and Masterman (1898 *b*, p. 351) regarded it as the subneural gland; but the view most generally accepted was that this organ corresponds to the vermiform process of certain Enteropneusta. In this paper it is called the notochord in accordance with the view of Harmer. The lumen of the notochord opens into the dorsal diverticulum of the pharynx. Masterman thought this the enlarged base of the duct, but the evidence is not strong enough to support the glandular nature of the notochord: I did not find a trace of mucus inside the lumen.

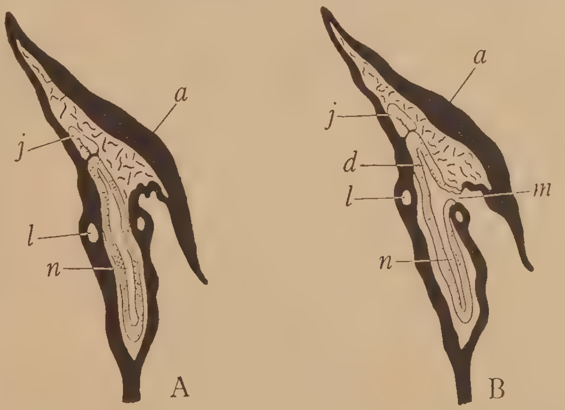

Fig. 6. Young bud of *C. nigrescens* (sagittal sections). A, early stage; B, later stage. *a*, proboscis; *d*, notochord; *j*, heart and pericardium; *l*, collar cavity; *m*, mouth; *n*, primitive gut.

Since the development of *Cephalodiscus* has not been worked out thoroughly it is difficult to say anything definite about the origin of the notochord, but it may be worth mentioning that during the development of the bud it is very conspicuous. In Fig. 6, A and B, drawings are given of sagittal sections of the young bud. The proboscis is very large and the collar cavities have just appeared as a ring. Within the trunk-cavity is the rod-shaped primitive gut, which has not as yet mouth-opening or intestinal loop. Later, the mouth is formed at about one-third the distance from the anterior end of the primitive gut. This stage has been figured by Harmer (1905, Pl. XIII, fig. 173). Later still, the pre-oral region of the primitive gut develops the characteristic appearance of the notochord. From the earliest stage its homology is revealed by the position of the heart and pericardium.

To draw any general conclusion from the development of the bud may not be justifiable, but it is recorded here since it shows a distinct stage in the formation of the notochord, which may serve for comparison when the embryonic development is worked out.

MUSCULAR SYSTEM

The muscular system of *Cephalodiscus* is well developed, and the zooids are capable of vigorous contraction. The chief muscles can be grouped as follows: (*a*) the muscles of the stalk, which are continuous with (*b*) the postero-ventral longitudinal muscles of the trunk, (*c*) longitudinal muscles of the collar, (*d*) longitudinal muscle of the arms, (*e*) transverse muscles of the proboscis and (*f*) "problematic" tissue situated on the roof of the collar pores.

Longitudinal muscles of the stolon are reflected on the ventral wall of the trunk. At the junction of the stolon and the body these muscles form three distinct tracts, which, diverging and broadening out slightly, run along the ventral body wall towards the bases of the right and left collar pores. On their course forwards some of the fibres terminate in the ventral body wall, so that the two bands become weaker as they approach the collar pores and are finally inserted into the septum between the trunk and collar cavities.

Two strong muscles are given off from the region of the collar canals; these traverse the collar cavities on each side of the mouth and end in the septum between the proboscis and collar cavities. From their relation to the mouth they are called the oral muscles. In the arms there are four bundles of longitudinal muscles, two strong bundles ventrally, one on each side of the food groove, and two weaker bundles in the dorsal wall.

The transverse muscles in the proboscis are grouped into bundles, which radiate from the septum between the proboscis and collar cavities. These muscles are attached to the ventral wall of the proboscis and their contraction enables the disc of the proboscis to be used as a sucker for the creeping movement of the zooids when they come out of the ostia.

Besides these definite muscle fibres there is a very prominent bundle of "problematic" tissue situated on the roof of each of the collar canals. These were regarded as lateral skeletal masses forming a fulcrum for the pre-oral muscles (Masterman, 1898 *b*, p. 348), but Harmer (1905, p. 46) observed that they constitute a series of oval lamellae which stain like muscle fibres, each connected along half its circumference with the roof of the collar canal and with the external body wall, the other half being freely exposed in the collar cavity. The oval lamellae appear in all details to be muscle fibres. They originate from the roof of the collar pore and radiate towards the dorsal and ventral walls of the collar. Most of these fibres are inserted into the collar septa, only those towards the middle remaining free in the collar cavity. In *C. densus* the distal ends of these fibres appear to be torn away from their attachments in the dorsal wall of the collar (Pl. XXXVII, fig. 1, *pt*). It is therefore probable that these are dilator muscle fibres which widen the lumen of the collar pores when water is drawn in, the connection of some of the fibres having been torn away by vigorous contraction when the zooids died.

VASCULAR SYSTEM

The vascular system of *Cephalodiscus* was described first by Masterman (1898 *b*, p. 350). He observed that it is composed of a pericardium situated on the tip of the notochord, a dorsal vessel running downwards in the mesentery of the collar, a system of sinuses round the stomach, vessels to the ovaries, a ventral vessel which divides into two at the base of the notochord and passes round the mouth to the anterior side of the body and stolon, vessels on the dorsal side of the body cavity of the arms and dorsal and ventral vessels in the stolon. He stated that the vascular system of *Cephalodiscus* is identical with that of *Balanoglossus*. The dorsal vessel communicates with the heart, and glomeruli occur in the ventral wall of the pericardium and in the ventral blood sinus. He also described a blood sinus running in the dorsal wall of the proboscis which was connected with the anterior glomerulus. Harmer (1905, p. 75) denied the existence of certain of the vessels described by Masterman. It was difficult to demonstrate that the dorsal and ventral vessels of the stolon were connected with similar vessels in the trunk; so he distinguished the spaces in the body as (*a*) vessels, the vascular nature of which was very clear, and (*b*) doubtful spaces. He recognized (1) the existence of the dorsal vessel which starts from the anterior caecal projection of the stomach and runs upwards parallel to the pharynx. This vessel, he believed, functioned as a reservoir of blood. He recognized also (2) vessels in the lateral mesentery passing ventral to the oviduct into the ovary and supplying it with nutriment, (3) two vessels in the stolon, the anterior vessel passing into the anterior part of the ventral mesentery and the posterior vessel passing into the ventral mesentery as far as the alimentary canal. To this detailed account there are only a few additions to make, and they are based only on the sections of *C. densus*. The space inside the heart as well as all the discernible vascular spaces are deeply stained and so it is easy to distinguish them from non-vascular spaces in the body.

In *C. densus* the heart is not situated on the tip of the notochord as in *C. dodecalophus* but on its ventral surface, so that the pericardium extends backwards almost parallel to the notochord. The heart is thick-walled and formed by the invagination of the posterior wall of the pericardium. The space inside the heart is dilated and deeply stained (Pl. XXXVII, figs. 1–4). This communicates directly with two blood vessels. A blood vessel originating from the dorsal side of the heart passes round the tip of the notochord, gives off a branch which runs forwards to the dorsal wall of the proboscis and proceeds backwards between the collar cavities close to the dorsal side of the notochord. Glomeruli occur on its walls in the hinder part, where it is very thick. On reaching the roof of the dorsal diverticulum of the pharynx it divides into two. These branches which I propose to call the pharyngeal blood vessels (Pl. XXXVII, fig. 2, pv_1 and pv_2) pass backwards close to the right and left sides of the pharynx to the base of the collar pores. The roof of the gill opening occurs immediately behind the collar pores and the right and left pharyngeal blood vessels on reaching the gill region come to an end abruptly. Though it could not be demonstrated in my material, it seems probable that the pharyngeal blood vessels break up into smaller branches which pass into the vacuolated cells of the gill region where the blood is oxygenated.

From the ventral posterior side of the heart is given off the ventral blood vessel, which at the base of the notochord divides into two lateral branches which pass along the dorsal wall of the collar cavities into the arms. In the arms these vessels are seen as deeply stained wavy lines running between the basement membrane and the coelomic epithelium. On the ventral side of the arms similar vessels occur which are directly connected with the median dorsal vessel. Pl. XXXVII, figs. 3 and 4 are transverse sections of the heart showing the cavity of the pericardium and heart. The pericardial cavity is not stained at all, whereas the space inside the heart is deeply stained. The wall of the heart is very thick and glomeruli occur on it. The section passes through the lower region of the heart and so the heart and pericardium appear only on the ventral side of the notochord. Dorsal to the notochord in the median septum between the right and left collar cavities runs the dorsal vessel already described. On the ventral posterior side of the heart there opens into it a very large vessel, the ventral blood vessel, which runs on the ventral side of the notochord. This dilates into a large space before it opens into the heart (Pl. XXXVII, fig. 1, *vv*). The dilated part has thick walls with glomeruli occurring on them. It is not certain whether the walls of the vessel are muscular. It follows the curve of the notochord and ends abruptly on the roof of the pharynx. The vessel which occurs in the median septum between the pharynx and the rectum is very probably a continuation of this vessel.

It has not been possible to work out the complete course of the circulation since the vessels are indistinct in parts of the body. But from the evidence it seems possible that the dorsal vessel conveys blood from the heart to the gills, arms and proboscis and that the ventral vessel collects blood and returns it to the heart.

In the stolon there are two vessels, the dorsal and ventral, but I have not been able to discover the connections of these vessels with the vessels of the body. Considering the specific differences in the relation of the stolon to the trunk, the connection of these blood vessels may not be the same in all species. In *C. hodgsoni* the stolon originates from the mid-ventral side of the body, in *C. densus* from the posterior extremity, and in *C. fumosus* near the mouth in the pharyngeal region (Pl. XXXVI, fig. 1). How far the position of the stolon would affect the connection of the stalk vessels with the vessels of the body is difficult to estimate.

NERVOUS SYSTEM

Detailed accounts of the nervous system of *Cephalodiscus* were given by Masterman and later by Harmer. Masterman (1898 *b*, p. 342) recognizes (1) the main ganglion on the dorsal wall of the proboscis and collar; (2) an anterior pre-oral nerve over the tip of the proboscis and spreading out as a thin plexus under the glandular part of the ventral wall; (3) nerves to the arms; (4) a pair of lateral nerves; (5) a post-oral ring from the posterior edge of the collar and (6) nerves into the stolon. I was not able to find all the nerves which Masterman described and the main course of the nerve tracts which I have determined seems to be somewhat different.

Fig. 7 is a drawing of the nervous system. From the anterior end of the main ganglion arises a thin plexus of nerves which spreads out laterally between the basement membrane and coelomic epithelium of the dorsal wall of the proboscis, the separate nerves become fused, round the lateral edges, with a thin plate of nerve plexus found under the glandular region of the ventral wall. This pre-oral nerve plexus does not extend to the anterior tip of the proboscis, so that Masterman's description of its course is incorrect. From the dorsal side of the ganglion arise the nerves to the arms; from the posterior end, a pair of post-oral nerves and a median nerve which runs in the dorsal wall of the trunk. This median nerve gives off a pair of small branches which enter the ducts of the gonads. The post-oral nerves, homologous with the "post-oral ring" of Masterman, proceed backwards on either side, and at the base of the collar pores each divides into three branches which enter the pharynx, post-oral lamella and body wall respectively.

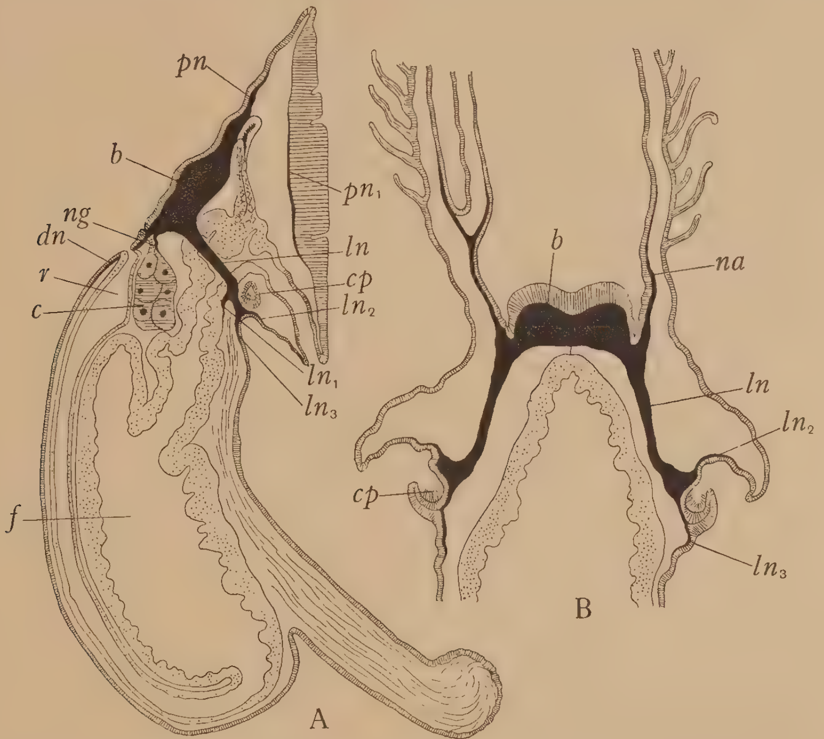

Fig. 7. *C. densus*. Nervous system. A, sagittal section; B, frontal section. *b*, ganglion; *c*, gonad; *cp*, collar pore; *f*, stomach; *pn*, pre-oral nerve plexus; pn_1, nerve plexus in ventral wall of proboscis; *ln*, post-oral nerve; ln_1, nerve to pharynx; ln_2, nerve to post-oral lamella; ln_3, nerve to ventral body wall; *ng*, nerve to gonad; *dn*, nerve to dorsal body wall; *na*, nerve to arms; *r*, rectum.

Pl. XXXVIII, figs. 1 to 8 are transverse sections which show the course of the main nerve tracts. Fig. 1 passes through the anterior region of the proboscis in front of the ganglion. Apart from the three layers of the body wall no trace of nerve plexus is seen in this region, and this supports my opinion that the pre-oral nerve plexus does not pass round the anterior tip of the proboscis. Harmer (1905, p. 72) also doubted the existence of such a nerve, though he believed the nerve plexus at the base of the glandular region of the ventral wall to be connected with the ganglion by a nerve which passed through the tip. Fig. 2 shows the region of the proboscis in front of the notochord. The proboscis cavity is very wide and contains inside it the proboscis canals and the heart and pericardium. Dorsal to the heart is the thick pre-oral nerve plexus which spreads out laterally on each side and becomes continuous with the nerve plexus of the ventral wall. Fig. 3 shows the ganglion, and, ventral to this, the heart and pericardium, the two proboscis pores and the anterior horns of the right and left collar cavities. The lateral plexus is more prominent and is seen extending to the sides. Fig. 4 shows the continuation of the ganglion in the dorsal wall of the collar from which nerves are given off to the arms. These nerves pass along the dorsal wall of the axis of the arms, and at the base of each arm spread out laterally forming a complete ring of nerve plexus. Fig. 5 shows the tip of the dorsal diverticulum of the pharynx and the origin of the main lateral post-oral nerves. These nerves proceed downwards along the right and left sides of the pharynx and in fig. 6 they are seen at the base of the post-oral lamella below the right and left collar pores. They give off three branches on each side, the first (ln_1) proceeds to the wall of the pharynx, the second (ln_2) passes along the posterior wall of the post-oral lamella, and the third (ln_3) goes to the ventro-lateral body wall. By the time fig. 8 is reached the lateral nerves become so small that they cannot be easily distinguished from the surrounding tissue. Beyond the region of the gill opening no distinct nerve tract is visible, and I was not able to discover the nerves in the stolon nor any sign of the lateral nerves extending into it.

In conclusion it may be pointed out that the pre-oral and lateral plexus together form a continuous plate of nerve plexus which spreads out from the anterior and lateral sides of the main ganglion in the dorsal wall of the proboscis. In the present account this is called the pre-oral nerve plexus. The paired lateral nerves and the "median pre-oral" nerve of Masterman are not distinct branches, but are only parts of this continuous plate of nerve plexus which in individual longitudinal and transverse sections appear like branches. The paired post-oral nerves do not form a complete ring but break up into branches at the base of the right and left collar pores.

CLASSIFICATION OF THE SPECIES OF *CEPHALODISCUS* WITH A LIST OF KNOWN FORMS

Ridewood (1918 *a*) gave a synopsis of the species of *Cephalodiscus* and a list of all recorded specimens in his contribution to the 'Terra Nova' reports. The present expedition has brought to light two new species. I therefore feel justified in revising the classification especially in view of the fact that a new sub-genus *Acoelothecia* had to be made for the new species *C. kempi*. With the incomplete knowledge of the limited number of species, it would be futile to search for a primitive type among them. The zooids of all recorded species, except for differences in the number of arms, size of body and position of stolon, are uniform in structure except *C. densus*, in which the structure of the gill region marks a distinct advance on the general type. The coenoecium of *Cephalodiscus* is marked by great diversity of form and structure upon which the classification into sub-genera is based.

In *Orthoecus* the colonies are in the form of cake-like masses, each zooid occupying a tube of its own. The different tubes are not continuous but are held together by the secretion of coenoecial substance between them. In one species—*C. fumosus*—the individual tubes are arranged vertically inside a common mass which is formed by the agglutination of minute particles of sand. This species and the diminutive disc-like colonies of *C. indicus* can be regarded as the bases upon which a hypothetical primitive type can be founded. Such a form will be a solitary individual which constructs a tube of its own, buried in the sand or mud of the sea-bottom, with habits like those of the allied group Enteropneusta.

The sub-genus *Orthoecus* is an intermediate stage between the primitive solitary hypothetical type and the typical colonial forms included in *Demiothecia* and *Acoelothecia*. In fact *Orthoecus* is only a gregarious group of organisms, each individual having an independent existence of its own. The tendency towards complete colonial life is more definite in *Idiothecia* where the colonies grow vertically. Though in *C. nigrescens* each individual has a tube of its own, the elaborate branching of the colonies and other habits are the evidence of a more communal life. This is accentuated in *C. agglutinans*, in which the different tubes are connected with each other resulting in a tubular labyrinth in the middle of the branch and this may be regarded as the bridge between *Idiothecia* and *Demiothecia*. Complete colonial life is met with in *Demiothecia* and *Acoelothecia*. The spaces inside the colony are continuous and the zooids occupy them in common, but of these two, *Acoelothecia* is more advanced, since the central tubular cavities are replaced by the elaborate meshwork which in Form B of *C. kempi* reaches great size and thickness.

In the following classification the diagnoses of the species not recorded in this report are adopted from Ridewood.

CEPHALODISCIDA

Genus **Cephalodiscus**, M'Intosh

Sub-genus **Orthoecus**, Andersson

Colonies in the form of a cake or cone or mass of irregular shape. Zooids occupying individual tubes, each with an ostium of its own, embedded in a common coenoecial substance or mass formed by the agglutination of minute particles. The tubes either closely set and parallel or irregularly bent and straggling.

C. indicus, Schepotieff. Colony diminutive, in the form of a small round plate; diameter 7 to 10 mm., height 3 to 4 mm. Ostia without any definite peristomial lip. Length of zooid 2·2 mm., arms three pairs, no end-swellings with refractive beads. South coast of Ceylon and Mahé (Malabar coast of India).

C. fumosus, n.sp. Colony in the form of a flat cake-like mass formed by agglutination of minute sand particles. Tubes vertical and parallel, with triangular peristomial lips. Length of zooids 3·2 mm.; dorsal side of body light brown. Arms eight pairs, with two black bands in the axis. No end-swellings with refractive beads. Buds on each zooid up to ten. Off Cape Bowles, Clarence Island.

C. solidus, Andersson. Colony not branching, in the form of a bulky mass or cake, measuring up to 300 mm. across, and 100 mm. high; the mass consisting of closely set vertically disposed tubes each with an ostium and peristomial tube at the upper end. The common coenoecial substance with or without sand grains. Length of zooid 4 to 5 mm. Colour of preserved zooid blackish. Arms eight pairs; no end-swellings with refractive beads. North of Joinville Island and off Mertz Glacier, Adélie Land.

C. densus, Andersson. Colony in the form of a bulky mass or cake, measuring up to 70 mm. high, consisting of closely set vertically disposed tubes of uniform diameter, each with transverse ostium at upper end. Common coenoecial substance soft and spongy, with or without sand grains. Length of zooids 4 to 11 mm. Colour of preserved zooids greyish or brownish white. Arms usually eight pairs. Buds on each zooid up to fourteen. Graham Land region, south-east of Seymour Island; Palmer Archipelago; off Queen Mary Land; McMurdo Sound, Ross Sea.

C. rarus, Andersson. Probably a synonym of *C. densus*.

C. anderssoni, Gravier. Colony a ragged bulky mass, measuring up to 105 mm. across; consisting of radially disposed tubes of uniform diameter, each with a transverse ostium devoid of peristomial lip. Basal parts of tubes cemented by common coenoecial substance into groups of four or five; partly incrusted with sand grains. Length of zooid 4 to 4·5 mm. Arms in buds six pairs, number in adult doubtful. South of Jenny Island, near Adelaide Island.

Sub-genus **Idiothecia**, Ridewood

Colony branching, each ostium leading into a tube occupied by one zooid and its buds. Tubes embedded in common coenoecial substance, and disposed at a more or less constant angle to the surface, either blind at their inner ends, or connected up in the middle of the branch.

C. nigrescens, Lankester. Colony branching, branches roughly cylindrical, colour greyish translucent; ostia at the end of short tubular peristomes, abaxial edge of peristome produced into a blunt lip. No spines. Each ostium leading into a tube which ends blindly in the middle part of the branch. Length of zooid 4 to 6 mm. Arms usually seven pairs, sometimes six or eight pairs, axis of arms with two black bands; no end-swellings with refractive beads. North-east of Coulman Island, Victoria Land; south of Jenny Island, near Adelaide Island; Palmer Archipelago; off Queen Mary Land; McMurdo Sound, Ross Sea.

C. levinseni, Harmer. Colony reddish orange, slightly branched. Width of branch not including peristomial tubes 3 to 5 mm. Ostia numerous, each leading into a tube that ends blindly in the middle part of the branch. Peristomial tubes projecting beyond the general surface about 4 mm. Length of zooids 2·5 mm. Colour of preserved zooids whitish. Arms six pairs; no end-swellings with refractive beads. Off west coast of Japan, at the south end of Corea Strait.

C. evansi, Ridewood. Colony massive, branching, coenoecium friable, cream coloured, speckled, containing large quantities of shells of Foraminifera, and fragments of shells of Molluscs and Echinoids. Ostia at the end of tubular peristomes that project 2·5 to 4·5 mm. from the surface of the branch. Length of the zooids 3·5 mm. Colour of preserved zooids, pale green or white. Arms usually eight pairs, no end-bulbs with refractive beads. Buds up to nine. New Zealand, Three Kings Islands.

C. gilchristi, Ridewood. Colony of long branches, some of the branches connected across by solid bars. Width of terminal branches 5 to 8 mm., colour brown or pale brown. Ostia numerous, except on main stem. Spine-like processes on the coenoecium numerous, slender, simple or forked. Zooids 1·6 to 1·8 mm. Colour of preserved zooids brown. Arms usually six pairs; no end-swellings with refractive beads. Off Cape St Blaize, Knysna Heads; Cape St Francis; East London; other localities on the south coast of Cape Colony, South Africa.

C. agglutinans, Harmer and Ridewood. Colony massive, branching. Coenoecium friable, cream coloured, speckled, opaque, containing large quantities of shells of Foraminifera, fragments of shells of Mollusca and spines of Echinoids and rounded particles of slate. No peristomial tubes. Each ostium with a thick lip or spine that projects about 3 mm. beyond the general surface. Each ostium leading into a tube that communicates at its inner end with a tubular labyrinth in the middle part of the branch. Length of the zooid 4·5 mm. Colour of preserved zooid blackish, arms eight or nine pairs, no end-swellings with refractive beads. Burdwood Bank, south of Falkland Islands.

Sub-genus **Demiothecia**, Ridewood

Colony branching. Each ostium leading into a cavity which is continuous through the colony, and is occupied in common by the zooids and their buds. The walls of the coenoecial cavity usually of irregular thickness and sometimes with inwardly projecting bars and ridges.

C. dodecalophus, M'Intosh. Colony irregularly branched and straggling; some of the branches fusing to form a network, the cross-bars being usually solid. Coenoecium pale orange-brown or colourless; width of branch excluding spines, 3·5 to 6 mm.; cavity of coenoecium continuous, but partially divided up by bars and incomplete partitions; occupied in common by zooids and their buds. Ostia numerous, irregularly placed, oval and without peristomial tubes. Spines obviously not related to ostia, simple, forked or branched. Length of zooids, 2 mm. Colour of preserved zooids, whitish or cream-coloured. Arms usually six pairs, sometimes five pairs, with end-swellings with refractive beads. Buds two or three. Straits of Magellan; east of southern end of Tierra del Fuego, Beagle Channel; between Falkland Islands and Burdwood Bank.

C. hodgsoni, Ridewood. Colony irregularly branched, cavity of coenoecium irregular, continuous and occupied in common by the zooids and their buds, inner surface smooth and sometimes traversed by solid bars. Ostia numerous, irregularly placed, lateral or terminal, each ostium with two to five more or less radiating spines, forked or branched. Length of zooids 2 to 3·2 mm. Zooids dimorphic; red zooids with six pairs of arms, females; brown zooids with ten or eleven arms, males. Arms with end-swellings with refractive beads. Buds two, sometimes three or four to each zooid. Ross Sea, east end of Barrier; in McMurdo Sound, south of Ross Island; Commonwealth Bay, Adélie Land; off Shackleton Glacier, Queen Mary Land; Graham Land Region, south-east of Seymour Island.

C. inaequatus (Andersson). Regarded as synonymous with *C. hodgsoni* by Ridewood.

C. aequatus, Andersson. Nearly related to *C. hodgsoni* and *C. dodecalophus*. Colony irregularly branched and straggling; coenoecium containing diatoms in great numbers. Length of zooids 2 mm. Colour of preserved zooids crimson-brown, fading to pale brown. Arms, six pairs in both sexes, with end-swellings with refractive beads. Buds two to four on each zooid. Graham Land Region, north of Joinville Island.

C. gracilis, Harmer. Colony very small and delicate, irregularly branched, creeping on a species of Polyzoa. Coenoecium almost colourless, the orange-coloured zooids within imparting a yellow tint to the colony. Cavity of coenoecium continuous, occupied by zooids and their buds in common. Ostia at the ends of branches, funnel-shaped; margin produced into three, four or five spines. Length of zooids 1·3 mm. Stolon with black pigment in the median line of the ventral surface. Arms five pairs; end-swellings with refractive beads found on the first pair of arms of the bud, occasionally on the second and third pairs also, sometimes persisting in the adult. East coast of Borneo.

C. sibogae, Harmer. Colony very small and delicate, irregularly branched, orange-coloured with dense basal encrusting part of coenoecium attached to stones; cavity of coenoecium continuous, occupied in common by the zooids and their buds. Ostia at the end of very short side branches, more or less alternate on opposite sides of the branch, funnel-shaped, with margin produced into two or three spines. Ordinary zooids, sterile, with large operculum and four pairs of arms. Male zooids with a single pair of arms without any trace of pinnules; the dorsal wall of the arms constituted by large number of refringent vesicles; the alimentary canal vestigial and the operculum absent. Colour blackish. Zooids, which otherwise resemble neuters, sometimes with functional testes. Northern entrance of Buton Strait, south-east of Celebes.

Sub-genus **Acoelothecia**, sub-gen. nov.

Colony small or large and branching, formed of a meshwork of bars and spines without any definite coenoecial cavities. Spaces between the meshwork irregular and continuous and occupied in common by the zooids and their buds.

C. kempi, n.sp. Colony small and tuft-like or large and branching. Inhabited part of coënoecium formed of an elaborate meshwork of bars and spines. Spines found all along the sides of branches; not related to ostia. Colour of coenoecium light brown to reddish brown. Length of zooid 1·8 to 2 mm. Arms five pairs, with end-swellings with refractive beads. Off Falkland Islands; off South Georgia.

NEW DATA SUMMARIZED

1. Two kinds of zooids are found in *C. hodgsoni*. Red zooids with twelve arms (female) and brown zooids with ten or eleven arms (males). Dimorphism being thus established, it is possible that *C. inaequatus* of Andersson is synonymous with *C. hodgsoni*, as suggested by Ridewood.
2. In *C. densus* a gill sac lies between the external gill opening and the pharynx.
3. *C. fumosus* is a new species, the zooids of which resemble those of *C. nigrescens*, but the coenoecium is formed by the agglutination of minute sand particles.
4. *C. kempi* is a new species which constructs a coenoecium formed of a meshwork of bars and spines. Because of this unique structure and the absence of distinct tubes for the zooids it is found necessary to create a new sub-genus *Acoelothecia*.
5. The red line on the proboscis and the pigmentation in the oviduct are believed to be sensory in function.
6. It has been shown that the dorsal vessel gives off two branches—the pharyngeal vessels—which enter the gills.
7. The main ganglion gives off the pre-oral plexus; and the paired post-oral nerves divide into three branches.

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PLATE XXXIII

Fig. 1. *C. hodgsoni.* Form A, St. 190.

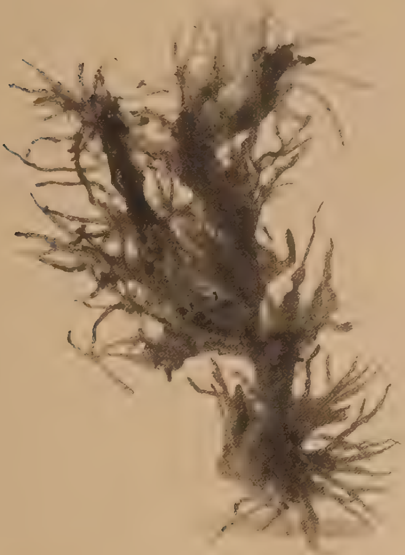
Fig. 2. *C. hodgsoni.* Form B, St. 190.

Fig. 3. *C. hodgsoni.* Form B, St. 190.

Fig. 4. *C. hodgsoni.* The single specimen obtained from St. 167.

Fig. 5. *C. hodgsoni.* The single specimen obtained from St. 187.

Fig. 6. *C. densus.* From St. 82.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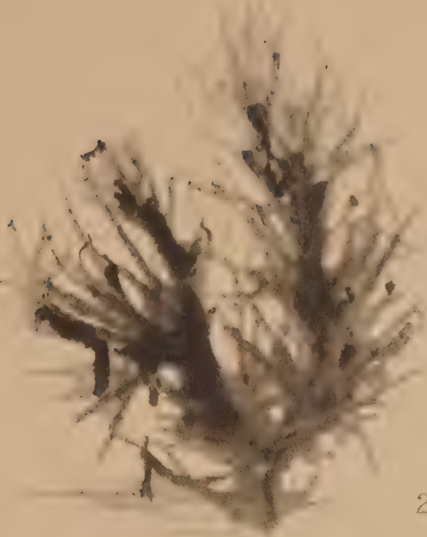
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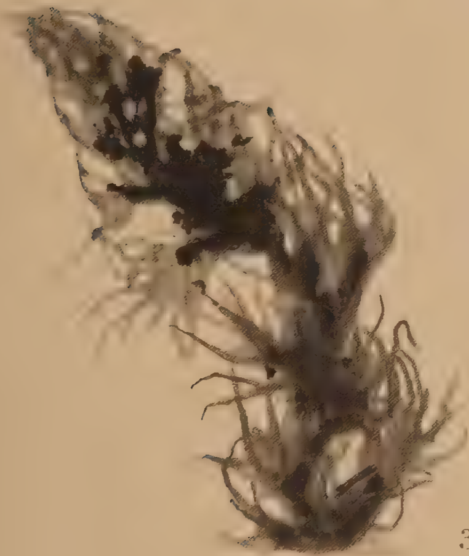
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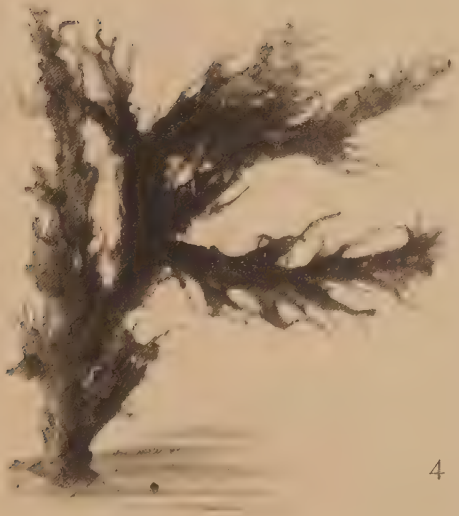
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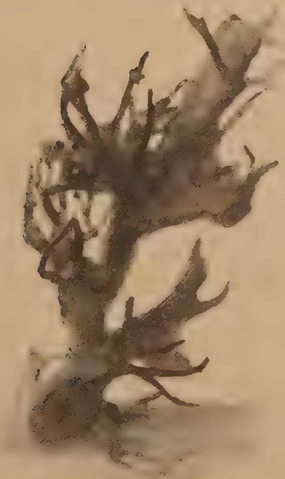
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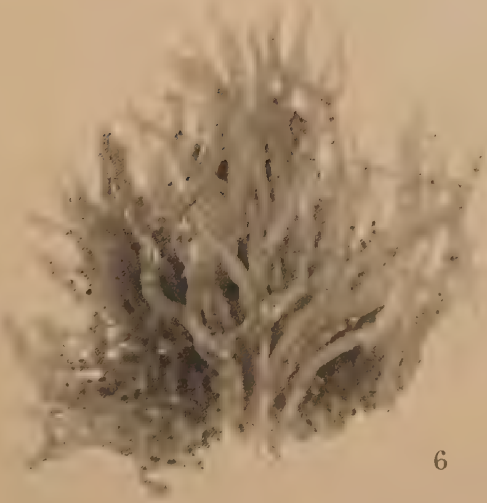
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CEPHALODISCUS

PLATE XXXIV

Fig. 1. *C. fumosus.* St. 170.

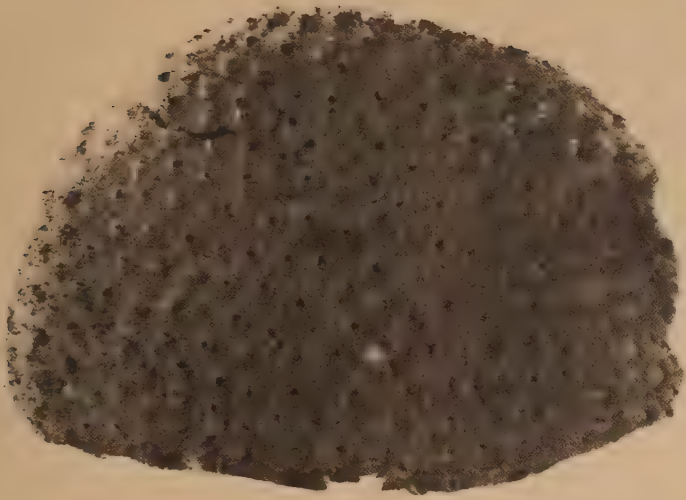
Fig. 2. *C. kempi.* Form B, from St. WS 97, basal part of a large colony.

Fig. 3. *C. kempi.* Form B, from St. WS 97, distal end of a branch showing the transparent growing region.

Fig. 4. *C. kempi.* Form A, from St. 158.

Fig. 5. *C. kempi.* Form B, from St. WS 97, the basal part of a thick branch photographed by transmitted light, showing the meshwork of the coenoecium.

Fig. 6. *C. kempi.* Form B, from St. WS 97, distal end of a branch photographed by transmitted light, showing the meshwork of the coenoecium and the mass of zooids.



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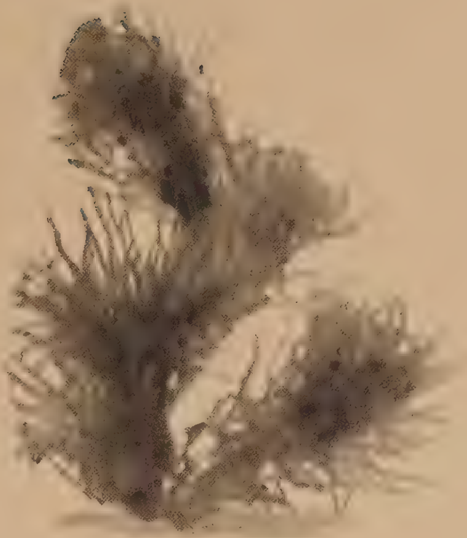

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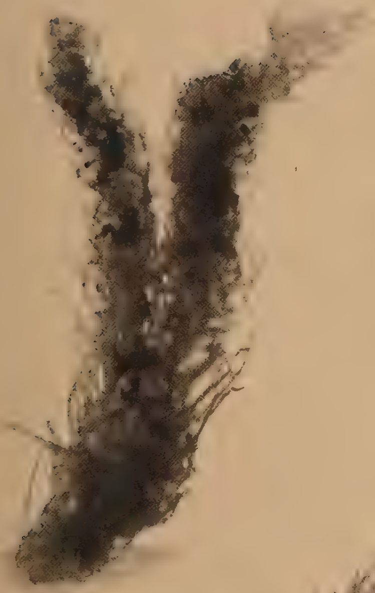

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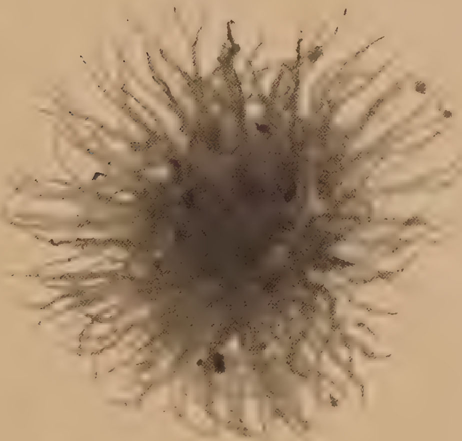

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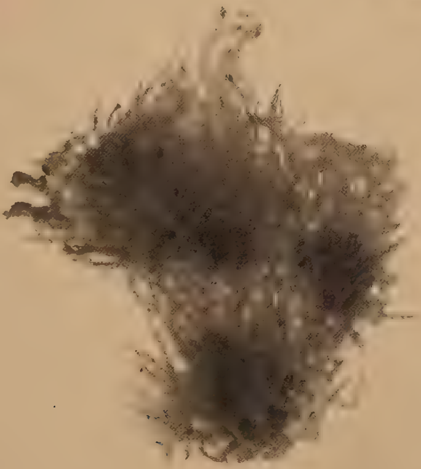

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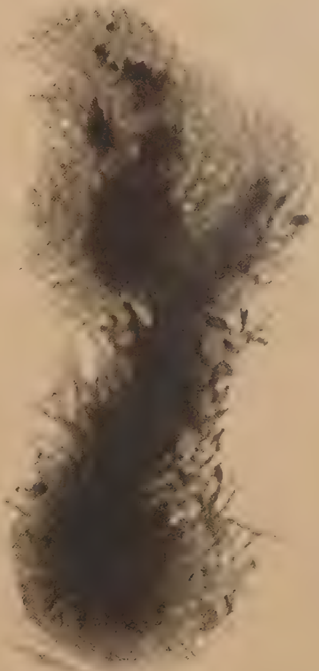

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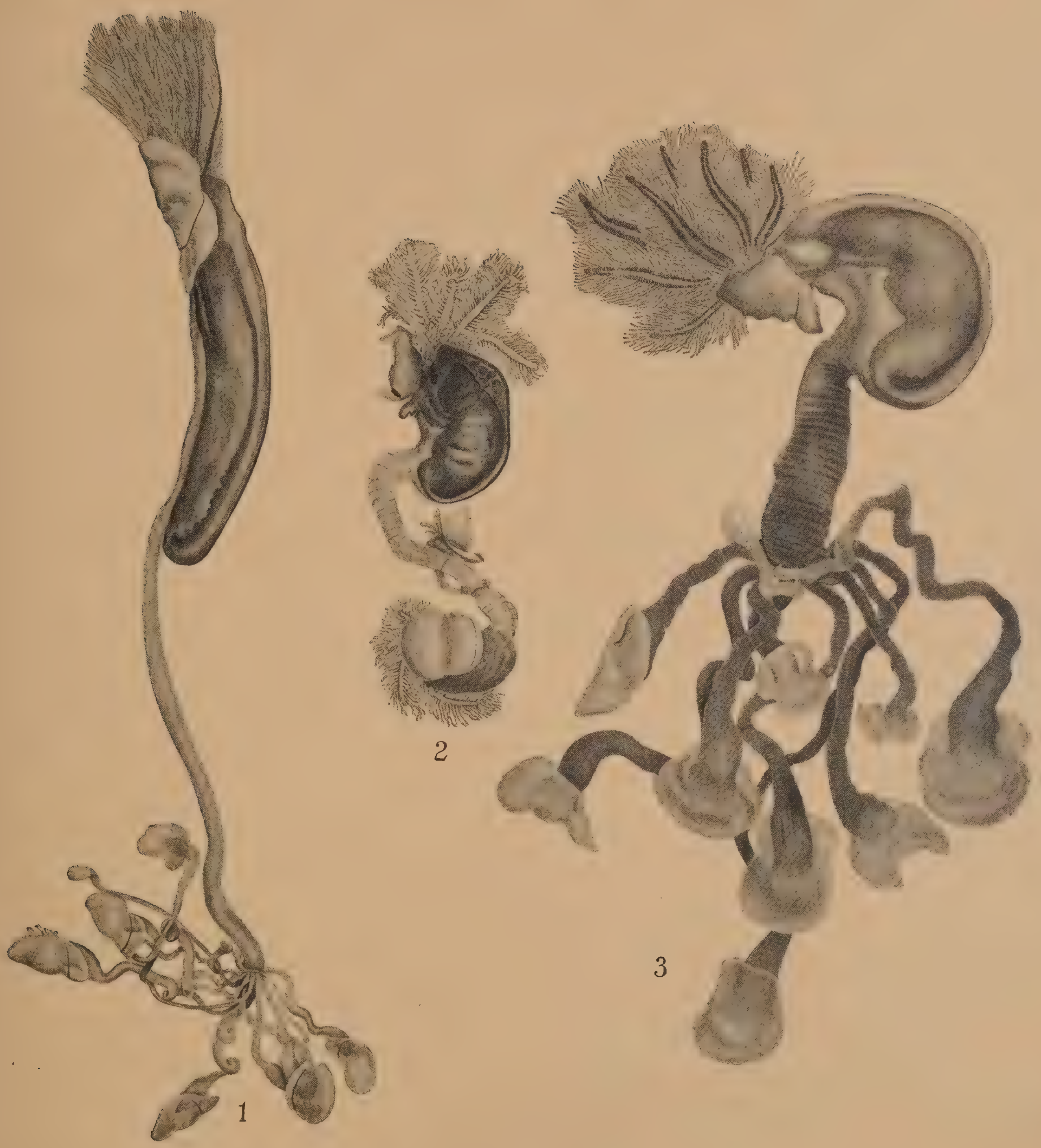
CEPHALODISCUS

PLATE XXXV

Fig. 1. Zooid of *C. densus*, from St. 82.

Fig. 2. Zooid of *C. kempi*, from St. WS 97.

Fig. 3. Zooid of *C. fumosus*, from St. 170.



CEPHALODISCUS

PLATE XXXVI

a, proboscis; *c*, gonads; *cc*, collar cavity; *eg*, external gill slit; *f*, stomach; *g*, intestine; *gc*, gill cavity; *h*, pharynx; *i*, stolon; *ig*, internal gill slit; *m*, mouth; *pd*, dorsal wall of the proboscis; *r*, rectum; *rb*, dorsal wall of the arms with refractive beads.

Fig. 1. *C. fumosus*, sagittal section, showing the attachment of the stolon.

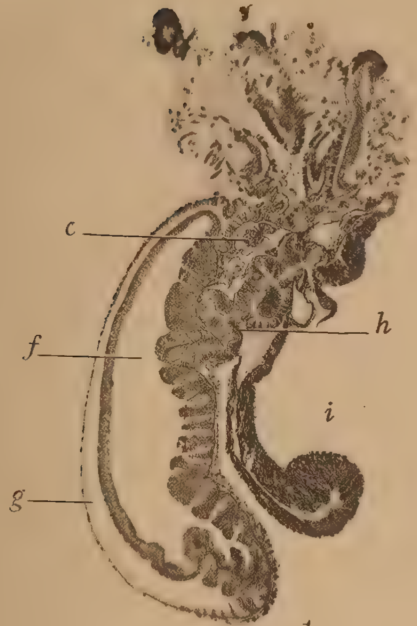
Fig. 2. *C. densus*, sagittal section, showing the refractive beads in the dorsal wall of the proboscis and arms.

Fig. 3. *C. densus*, sagittal section, showing the gill cavity and the external and internal gill openings.

Fig. 4. *C. densus*, transverse section, passing through the external gill slit.

Fig. 5. *C. densus*, transverse section passing through the gill cavity.

Fig. 6. *C. densus*, transverse section passing through the internal gill slit.



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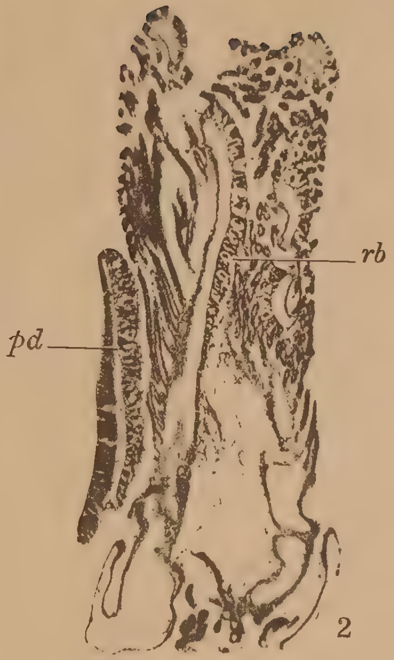

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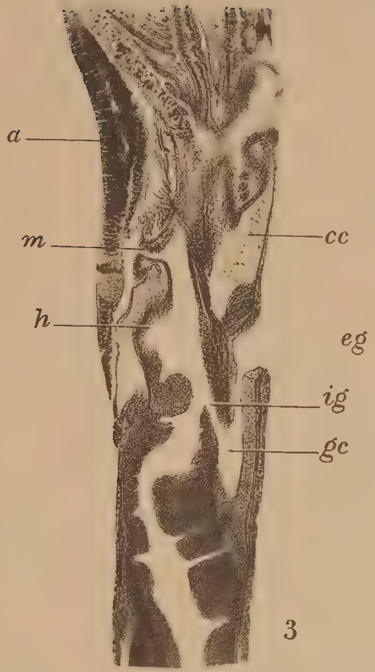
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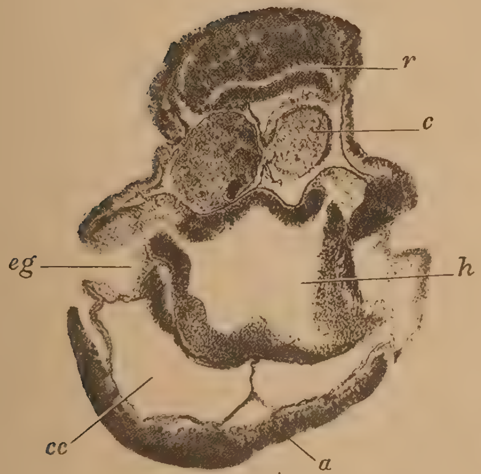

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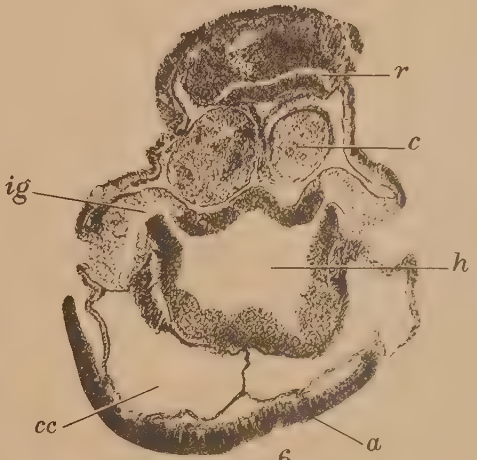

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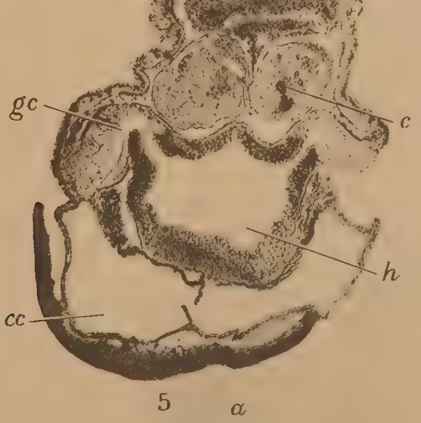

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CEPHALODISCUS

PLATE XXXVII

a, proboscis; *b*, ganglion; *cc*, collar cavity; *ch*, cavity of heart; *cp*, collar pore; *d*, notochord; *dv*, dorsal blood vessel; *eg*, external gill-slit; *gr*, roof of gill slit; *h*, pharynx; *j*, pericardium; *jc*, pericardial cavity; *p*, *pc*, proboscis cavity; *pt*, problematic tissue; pv_1 and pv_2, pharyngeal blood vessels; *vv*, ventral blood vessel.

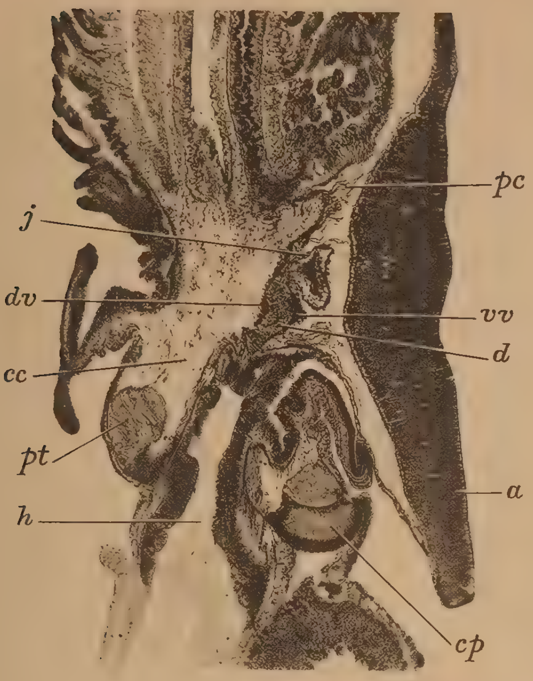
Fig. 1. *C. densus*, sagittal section through collar region.

Fig. 2. *C. densus*, sagittal section through collar region.

Fig. 3. *C. densus*, transverse section through the heart and pericardium.

Fig. 4. *C. densus*, transverse section of heart and pericardium.

Fig. 5. *C. nigrescens*, transverse section passing through heart and pericardium.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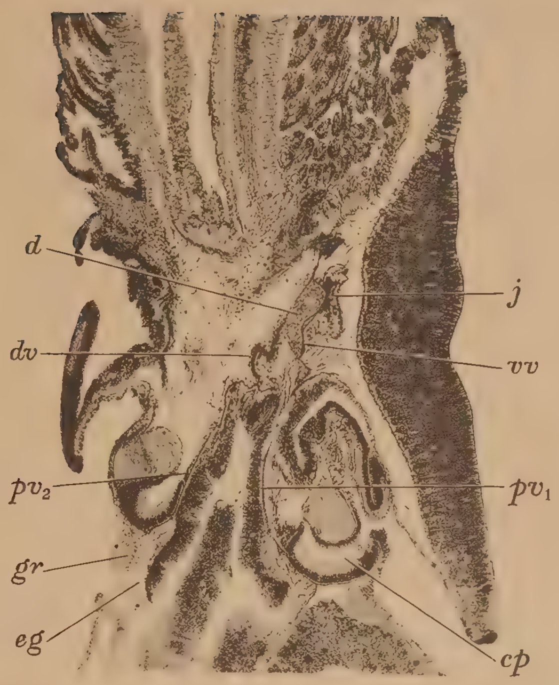
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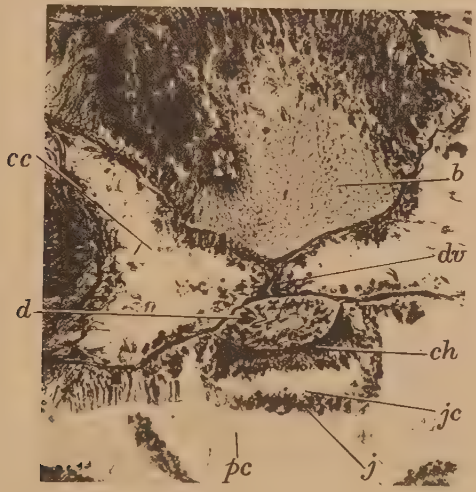
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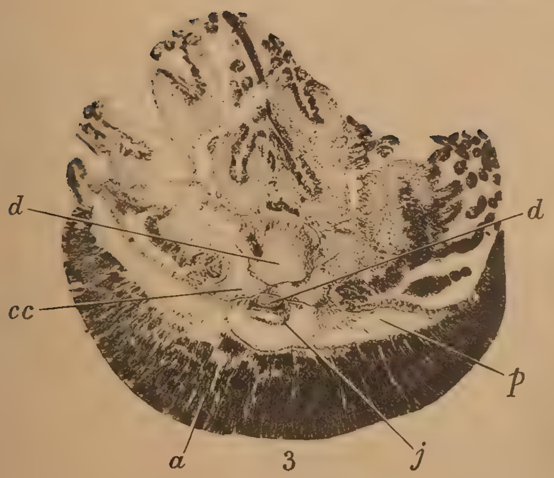

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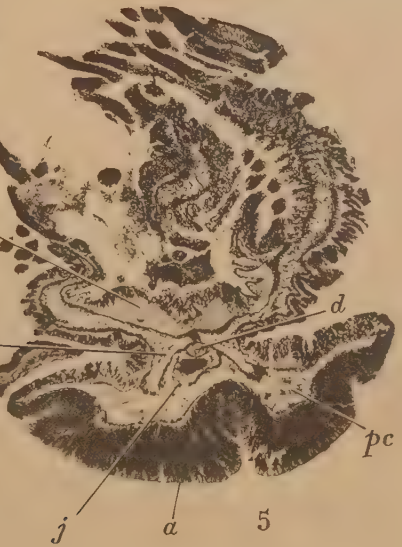

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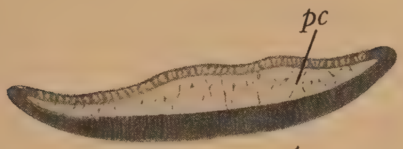
CEPHALODISCUS

PLATE XXXVIII

b, ganglion; *bc*, body cavity; *c*, gonad; *cc*, collar cavity; *cp*, collar-pore; *d*, notochord; *dh*, diverticulum of pharynx; *e*, post-oral lamella; *eg*, gill-slit; *h*, pharynx; *j*, heart and pericardium; *ln*, post-oral nerve; ln_1, nerve to pharynx; ln_2, nerve to post-oral lamella; ln_3, nerve to body wall; *na*, nerve to arms; *pc*, pericardial cavity; *pl*, pleurochord; *pn*, pre-oral nerve plexus; pn_1, nerve plexus in the ventral wall of proboscis; *pp*, proboscis pore canal; *r*, rectum.

Figs. 1 to 8. Series of transverse sections of *C. densus* showing the nervous system.



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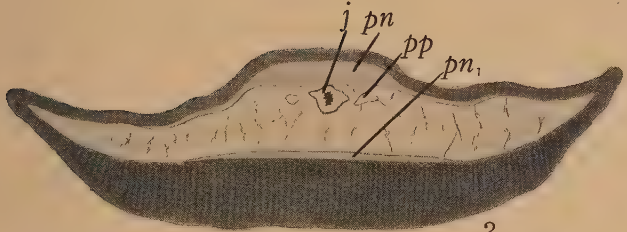

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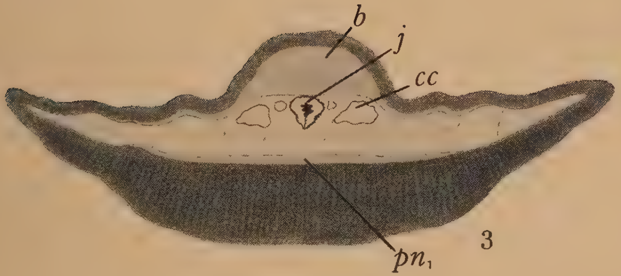

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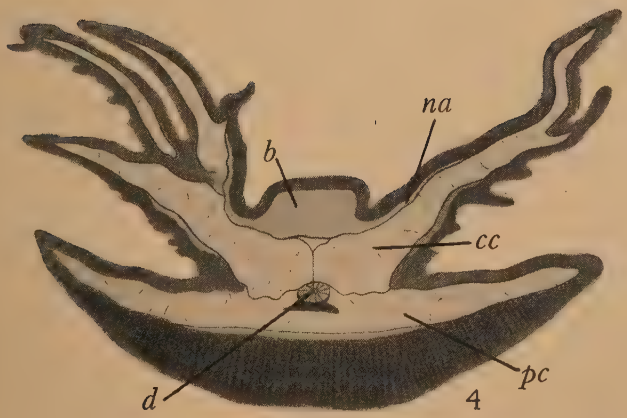

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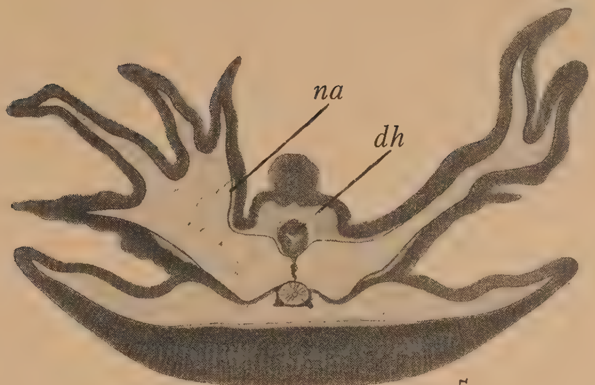

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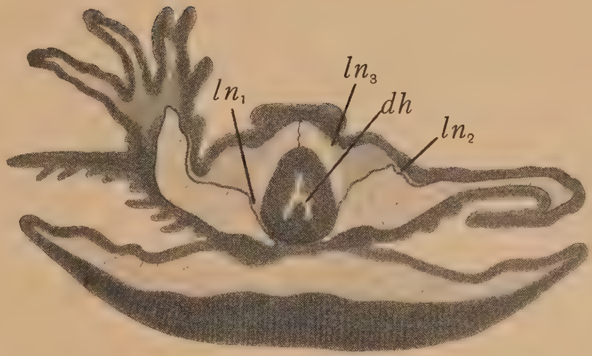
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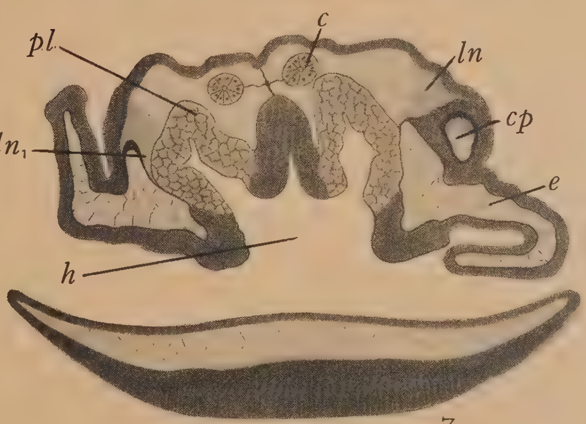
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ln_1
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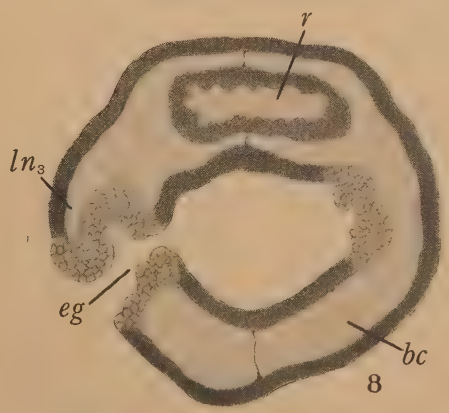

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CEPHALODISCUS

[*Discovery Reports. Vol. III, pp.* 261–266, *November*, 1931.]

SPIDERS COLLECTED BY THE DISCOVERY EXPEDITION WITH A DESCRIPTION OF A NEW SPECIES FROM SOUTH GEORGIA

By

W. S. BRISTOWE, B.A., F.Z.S.

SPIDERS COLLECTED BY THE DISCOVERY EXPEDITION

WITH A DESCRIPTION OF A NEW SPECIES FROM SOUTH GEORGIA

By W. S. Bristowe, B.A., F.Z.S.

(Text-fig. 1)

ANALYSIS OF THE COLLECTION

THE collection comprises nineteen specimens which are attributable to three species contained in tubes labelled as follows:

Ascension Island

Artema mauricia Walck. 1 ♂.

"1925. Presented by Mr L. W. Shaw."

Hermite Island, Cape Horn

Rubrius subfasciatus E. Sim. 1 ♀, 1 young specimen.

"St Martin's Cove. St. 222, 23. iv. 27. Sh. coll."

South Georgia

Myro frigida sp.nov. 7 ♀, 2 ♂, 7 young specimens from:

1. E. Cumberland Bay. 3 ♀. MS 10, 28. iv. 25.
2. E. Cumberland Bay. 1 ♀, 1 ♂, 7 young. MS 71, 9. iii. 26.
3. Grytviken. 1 ♂. 6. iii. 26.
4. New Fortuna Bay. 1 ♀. Beach Collecting. On Whale Bone.
5. Wilson Habour. 1 ♀. WS 62, 19. i. 27. Moss Dweller.
6. South Georgia. 1 ♀. 18. ii. 27. Found in jar labelled "Whale parasites".

NOTES

That the collection should comprise but three species is somewhat disappointing, but, as I shall show below, it is probable that the total spider fauna of South Georgia consists of a single species and that a very interesting one. If opportunity arises it is to be hoped that spiders will be collected on other Antarctic islands and their discovery on the Antarctic Continent would be of particular interest. After all Attids of the genus *Sitticus* were found living at 23,000 ft. on Mount Everest in spite of the absence of vegetation, so it may not be too much to expect them on inhospitable Antarctic lands.

Artema mauricia Walck., which was brought back from Ascension Island, is world-wide in tropical and sub-tropical countries. It has a long list of synonyms including *A. atlanta* Walck., *Pholcus borbonicus* Vinson and *Artema convexa* Bl., and has been recorded under the last of these from St Helena, 700 miles south-west of Ascension.

Rubrius subfasciatus Sim. appears to be common in Tierra del Fuego, and has previously been collected on Hermite Island.

Coming now to the third and new species, which I am calling *Myro frigida*, we find much of interest in its discovery in South Georgia.

No spiders had previously been collected in South Georgia and now, out of sixteen specimens from four or five different localities, this is the only species to be found. It is small and it is not conspicuous, so we have grounds for thinking that it is the only spider inhabitant of South Georgia. An interesting fact, which incidentally supports this view, is that the isolated Antarctic islands of Kerguelen and Macquarie also have one spider inhabitant in each case peculiar to themselves and in each case belonging to the genus *Myro*.

So far as I am aware the distribution of this genus is as follows: Cape of Good Hope, Snares Island, Macquarie Island, Tasmania, Kerguelen and now South Georgia.[1] Each locality has its own peculiar species and Snares Island can boast of two.

Myro, and also *Rubrius*, belong to a sub-family of the Agelenidae, the Cybaeinae, and L. Berland has recently pointed out that no less than eight out of the fourteen species known from Bounty, Snares, Auckland, Campbell, Macquarie and Kerguelen Islands belong to this sub-family,[2] or nine to the family Agelenidae.

Thus by adding South Georgia to the above list of islands we can say that of their known fauna ten out of fifteen, or two-thirds, belong to the family Agelenidae and nine out of fifteen, or three-fifths, to the sub-family Cybaeinae. Furthermore, of the nine Cybaeinae seven are peculiar to the particular island on which each is found, the other two being shared by Auckland and Campbell.

This is a very different state of affairs to that existing in the Arctic. There the Linyphiidae are the predominant family, and there the isolated small islands do not have any, or at any rate many, species peculiar to their faunas. Taking the four islands of Jan Mayen, Bear Island, Spitsbergen and the New Siberian Islands we find that out of ten species, nine belong to the Linyphiidae and one, *Micaria eltoni* Jacks., to the Clubionidae. Three of the four Jan Mayen species are found on Spitsbergen and the fourth on Bear Island. The three species recorded for the New Siberian Islands are all present on Spitsbergen.

This comparison of Arctic with Antarctic islands shows us (1) that in the former it is the Linyphiidae, in the latter the Agelenidae that are dominant, and (2) that in the former the restriction of species to particular islands is the exception, whilst in the latter it is the general rule. Have these two points any connection with one another? Is there any connection between the facts that in the Arctic eight out of nine Linyphiids on these four islands are not peculiar to any one of them (and most of them are found in Arctic Europe or Greenland), whilst in the Antarctic seven out of nine Cybaeinae are restricted to particular islands? Elsewhere[3] I have stressed the fact that the ballooning habit is the most efficient means that spiders have of dispersing themselves and that the Linyphiidae are the most frequent aeronauts. Still more recently in a paper on the spiders of Krakatau Island, which is in course of publication in the *Proceedings of the Zoological Society*, I have suggested that certain families never make use of this means of dispersal and the Agelenidae seldom or never. This does not mean that it is impossible for the Cybaeinae to cross the sea, but it does remove their most efficient means of doing so, and it suggests to our minds that a simple explanation of our difficulties would be that land connections existed in the past between these Antarctic islands and a mainland, such as the Antarctic Continent.

---

[1] *Myro backhauseni* Sim. and *M. paupercula* Sim. described from the south of South America have now been transferred to the genus *Myropsis* and the family Dictynidae.

[2] *Compte Rendu Sommaire des Séances de la Soc. de Biogéographie*, 1930, p. 90.

[3] *Proc. Zool. Soc.* Pt 4, 1929, p. 633.

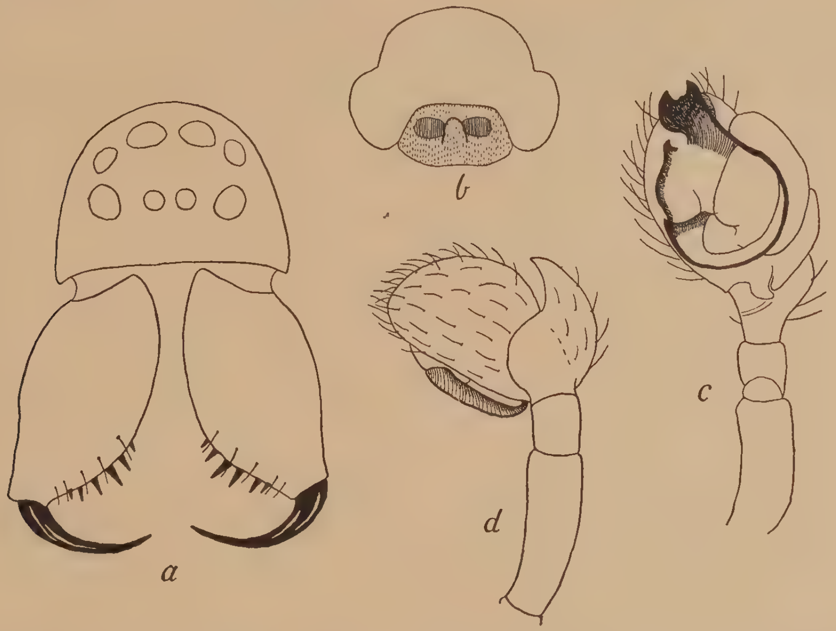

Fig. 1. *Myro frigida*, sp.nov. *a*, eyes and chelicerae. *b*, female epigyne. *c*, *d*, male palp from below and above.

Myro frigida, sp.nov.

Size. Female 2·5 to 3 mm., male 2 to 2·5 mm.

Eyes. Median anterior eyes easily the smallest; seen from in front, they lie slightly above a line joining the base of the anterior lateral eyes, but not nearly so far above such a line as in the type species *M. kerguelenensis* Camb. or *M. caffer* Sim. (Compare Fig. 1 *a* with figure by O. P. Cambridge in *Proc. Zool. Soc.* 1876, p. 258, and E. Simon in *Histoire Naturelle des Araignées*, Tome 2, p. 237.) Eyes on dark patches.

Chelicerae. Vertical. The dentition of the teeth differentiates this species from those previously described in so far as the descriptions allow such a comparison being made. In the present species the front or outer row consists of six rather sharp thin teeth diminishing in size at each end of the row. The inner row comprises three small teeth.

Sternum. Dark and somewhat heart-shaped with a narrow extension posteriorly passing between the hind coxae.

Abdomen. Clothed with short fine hair. A tolerably clear pattern somewhat similar to that of *Myro kerguelenensis* Camb., posteriorly with pale bars on a dark background meeting at an angle directed forwards. Anteriorly these bars give place to pale elongated patches or spots.

The female vulva is fairly large, dark and prominent.

The inferior spinners are the longest and strongest.

Cephalothorax. Yellow-brown with dark line markings as in *M. kerguelenensis*. A few spinous hairs anteriorly.

Legs. Pale yellow-brown, the third pair being slightly the shortest. Terminated by three claws. Legs clothed mainly with stiff bristles.

Habitat. Various localities in the island of South Georgia under stones on beach and amongst moss. Also "on the walls and stones outside the Marine Biological Station, Grytviken".

[*Discovery Reports. Vol. III, pp.* 267–296, *Plate XXXIX, March* 1932]

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INVESTIGATIONS

MOLLUSCA: GASTROPODA THECOSOMATA AND GYMNOSOMATA

BY (THE LATE)

ANNE L. MASSY

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PLATE XXXIX . . . . following page 296

MOLLUSCA: GASTROPODA THECOSOMATA AND GYMNOSOMATA

By (the late) Anne L. Massy

(Plate XXXIX; text-fig. 1)

INTRODUCTION

The pelagic Mollusca, usually known as Pteropods, which form the subject of this report, attracted at an early date the attention of ship captains and naturalist voyagers, for they exist in the open sea far from any shelter other than that afforded by drifting weed and sometimes occur in vast swarms. Individually they are very small. Indeed, one of the larger species fully extended measures scarcely more than an inch.

The Thecosomata are protected by fragile shells, which may be coiled, triangular or needle-shaped. One family, the Cymbuliidae, possesses slipper-shaped gelatinous conchae of great beauty. The Gymnosomata, as their name implies, are without shells. All are hermaphrodite and some species of Gymnosomata have been observed to be very precocious in reaching sexual maturity: thus, Pelseneer (1887, p. 49) alludes to a specimen of *Clione flavescens* (Ggbr.) that was able to lay eggs although it was hardly 2·0 mm. in length and still possessed ciliated rings. Kwietniewski (1902, p. 17) states that in a number of other species the sexual elements develop early. In 1917 I noted that specimens of *Pneumodermopsis paucidens* (Boas) from the west of Ireland, measuring only 1–2·5 mm. in length, had external accessory glands, and an individual measuring only 0·75 mm. had the penis evaginated (Massy, 1917, pp. 231–232).

Diurnal migration is a well-established phenomenon in this group.

Pteropods serve as food for some of our most valuable food fishes[1] and for sea birds. They are said also to form the food of whales, and as early as 1770 Cranz, in his *Historie von Grönland*, named *Clione* "Walfischfrass" (food devoured greedily by the whale). The earliest mention of the group appears to have been made in 1780 when Fabricius produced his *Fauna of Greenland* and described *Limacina helicina*, Phipps, under the name *Argonauta arctica*.

In the course of the Discovery Investigations many thousands of Pteropods have been taken. A special study of the plankton has been made in southern waters near South Georgia, the South Sandwich and the South Shetland Islands and the distribution of the five species of Pteropods, to one or other of which the many individuals belonged, is dealt with in a separate report. In warmer regions far fewer individuals were captured, but thirty-one species belonging to eighteen genera were represented.

---

[1] Statistics in the Irish Fisheries Office of the stomachs of herring and mackerel taken on the west coast of Ireland show that *Clione* is a common food in spring and autumn.

Much has been written about the bipolarity of pelagic animals. Prof. D'Arcy Thompson[1], in his paper on "Marine Faunas" (p. 348), shows that the bipolar hypothesis may be rejected in the case of the Tunicata, Holothurians, Crustacea and fish. As regards the Pteropods, *Cleodora sulcata* (Pfeffer) and *Clione antarctica*, E. A. Smith, seem to be closely allied to, but specifically distinct from, *Cleodora pyramidata* (L.) and *Clione limacina*, Phipps. *Limacina helicina*, Phipps, on the other hand, is distributed at both poles.

Some writers have thought that the more archaic species might be expected to exist near the poles, while others have suggested that the more original forms would be found in the warmer regions of the ocean. It seems probable that Chun's theory, that in the case of pelagic animals the deep-sea fauna contains the most primitive types, is right. Bonnevie has shown that three deep-water species, namely *Peraclis diversa*, Monterosato, *Limacina helicoides*, Jeff., and *Cleodora falcata*, Pfeffer, all exhibit archaic characters. These are all represented in the present collection: *Peraclis diversa*, Monterosato was taken north of the equator at 0–800 m. and at 2500–2700 m. *L. helicoides* occurred north-east of the Falkland Islands, off Tristan da Cunha and in three hauls west of the Cape of Good Hope: the nets were fished at 600–2500 m. *Cleodora falcata*, Pfeffer, was taken north-east of the Falkland Islands in soundings of 1050–1350 (–0) m.

I wish to express my thanks to Dr Kemp and the Discovery Committee for allowing me to work out this collection, to Miss Barnes of the Dublin Museum, and lastly to Madame Pruvot-Fol, who spared time to give me valuable help on several points and whose drawings of the radula and jaws of the rare *Spongiobranchaea intermedia*, Pruvot-Fol, are included in this Report.

LIST OF STATIONS

The following table gives the positions and other data of the stations to which reference is made in the text. Stations made by R.R.S. 'Discovery' have no letters prefixed to the numbers; those of the R.R.S. 'William Scoresby' have the prefix WS; and those made from the S.S. 'Anglo-Norse' have the prefix SS denoting 'South Sandwich.'

Station	Position	Date	Sounding (m.)
8	42° 36′ 30″ S, 18° 19′ 30″ W	8. ii. 25	3375
11	50° 26′ 00″ S, 30° 27′ 00″ W	16. ii. 26	5000
12	51° 55′ 00″ S, 32° 27′ 30″ W	18. ii. 26	2744
37	28 miles N 36 E of Jason Lt, S. Georgia	18–19. iii. 26	—
62	49° 22′ 00″ S, 54° 48′ 00″ W	22. v. 26	—
66	48° 09′ 00″ S, 52° 50′ 00″ W	23. v. 26	—
68	46° 40′ 00″ S, 51° 22′ 00″ W	24. v. 26	—
71	43° 20′ 00″ S, 46° 02′ 00″ W	30. v. 26	5460
72	41° 43′ 20″ S, 42° 20′ 40″ W	1. vi. 26	5420
78	35° 18′ 00″ S, 19° 01′ 10″ W	12. vi. 26	3410
80	32° 46′ 00″ S, 10° 00′ 00″ W	17. vi. 26	—
81	32° 45′ 00″ S, 8° 47′ 00″ W	18. vi. 26	—
84	32° 52′ 00″ S, 1° 55′ 00″ E	22. vi. 26	2233
85	33° 07′ 40″ S, 4° 30′ 20″ E	23. vi. 26	4943
86	33° 25′ 00″ S, 6° 31′ 00″ E	24. vi. 26	—

---

[1] *Proc. Roy. Soc. Edinburgh*, 1898.

Station	Position	Date	Sounding (m.)
87	33° 53′ 45″ S, 9° 26′ 30″ E	25. vi. 26	5081
88	34° 04′ 00″ S, 13° 00′ 00″ E	27. vi. 26	—
89	34° 05′ 15″ S, 16° 00′ 45″ E	28. vi. 26	3926
100	33° 20′ 00″ to 33° 46′ 00″ S	2–4. x. 26	—
	15° 18′ 00″ to 15° 08′ 00″ E		—
101	33° 50′ 00″ to 34° 13′ 00″ S 16° 04′ 00″ to 15° 49′ 00″ E	14–15. x. 26	3734
107	45° 03′ 00″ S, 17° 03′ 00″ E	4. xi. 26	—
110	47° 54′ 00″ S, 12° 39′ 30″ E	7. xi. 26	—
114	52° 25′ 00″ S, 9° 50′ 00″ E	12. xi. 26	—
130	54° 06′ 00″ S, 36° 23′ 00″ W	20. xii. 26	122
133	53° 45′ 30″ S, 35° 46′ 30″ E	20–21. xii. 26	802
136	54° 22′ 00″ S, 35° 21′ 00″ W	21. xii. 26	246
231	51° 29′ 30″ S, 57° 18′ 15″ W	28. v. 27	143
238	48° 12′ 00″ S, 51° 56′ 30″ W	31. v. 27	—
239	46° 56′ 00″ S, 46° 03′ 00″ W	2. vi. 27	—
244	38° 26′ 30″ S, 24° 48′ 30″ W	9. vi. 27	—
257	35° 01′ 00″ S, 10° 18′ 00″ E	24. vi. 27	—
270	13° 58′ 30″ S, 11° 43′ 30″ E	27. vii. 27	—
273	9° 38′ 00″ S, 12° 42′ 30″ E	31. vii. 27	—
276	5° 54′ 00″ S, 11° 19′ 00″ E	5. viii. 27	—
279	Off Cape Lopez, French Congo. From 8·5 miles N 71° E to 15 miles N 24° E of Cape Lopez Lt.	10. viii. 27	58–67
287	2° 49′ 30″ S, 9° 25′ 30″ W	19. viii. 27	—
288	00° 56′ 00″ S, 14° 08′ 30″ W	21. viii. 27	—
289	3° 04′ 45″ N, 16° 52′ 00″ W	23–24. viii. 27	—
294	4° 33′ 15″ N, 16° 52′ 45″ W	25. viii. 27	—
295	5° 30′ 30″ N, 17° 45′ 00″ W	25. viii. 27	—
297	12′ 08° 00″ N, 20° 53′ 30″ W	28. viii. 27	—
WS 37	54° 45′ 00″ S, 35° 11′ 00″ W	22. xii. 26	318
SS 7	54° 19′ 20″ S, 29° 32′ 40″ W	29. xi. 27	—
SS 9	54° 31′ 00″ S, 29° 40′ 00″ W	2. xii. 27	—
SS 10	54° 30′ 20″ S, 29° 38′ 45″ W	2. xii. 27	—
SS 14	54° 30′ 00″ S, 30° 11′ 00″ W	11. xii. 27	—
SS 15	54° 22′ 00″ S, 30° 11′ 00″ W	11. xii. 27	—
SS 22	55° 56′ 00″ S, 25° 56′ 00″ W	22. xii. 27	—
SS 31	60° 59′ 00″ S, 25° 55′ 30″ W	18. i. 28	—
SS 34	60° 51′ 00″ S, 26° 25′ 00″ W	21. i. 28	—
SS 35	60° 49′ 00″ S, 26° 32′ 00″ W	21. i. 28	—
SS 45	62° 17′ 45″ S, 27° 15′ 45″ W	3. ii. 28	—
SS 52	62° 15′ 00″ S, 21° 36′ 20″ W	15. ii. 28	—
SS 54	60° 59′ 20″ S, 23° 21′ 50″ W	20. ii. 28	—
SS 58	61° 55′ 00″ S, 23° 40′ 00″ W	23. ii. 28	—

LIST OF SPECIES

A. South Georgia and the South Shetland Islands.

Eupteropoda (Thecosomata).
- *Cleodora sulcata* (Pfeffer).
- *Limacina helicina* (Phipps).
- *Limacina balea* (Möller).

Pterota (Gymnosomata).
- *Clione antarctica*, E. A. Smith.
- *Spongiobranchaea australis*, d'Orbigny.

B. South Atlantic.

Eupteropoda (Thecosomata).
- *Cavolinia longirostris* (Lesueur).
- *Cavolinia gibbosa* (Rang) in d'Orbigny.
- *Cavolinia inflexa* (Lesueur).
- *Cavolinia tridentata* (Forskål).
- *Cavolinia uncinata* (Rang) in d'Orbigny.
- *Cleodora pyramidata* (L.).
- *Cleodora cuspidata* (Bosc.).
- *Cleodora balantium*, Rang.
- *Cleodora falcata*, Pfeffer.
- *Cleodora sulcata* (Pfeffer).
- *Hyalocylix* (*Creseis*) *striata*, Rang.
- *Styliola* (*Creseis*) *subula* (Quoy and Gaimard).
- *Cuvierina columnella* (Rang).
- *Limacina helicina* (Phipps).
- *Limacina balea*, Möller.
- *Limacina retroversa* (Fleming).
- *Limacina helicoides*, Jeffreys.
- *Limacina bulimoïdes*, d'Orbigny.
- *Peraclis diversa*, Monterosato.
- *Procymbulia valdiviae*, Meisenheimer.
- *Cymbulia peroni*, Blainville.
- *Cymbuliopsis intermedia*, Tesch.

Pterota (Gymnosomata).
- *Pneumoderma atlanticum*, Oken.
- *Spongiobranchaea australis*, d'Orbigny.
- *Spongiobranchaea intermedia*, A. Pruvot-Fol.
- *Pneumodermopsis macrochira*, Meisenheimer.
- *Schizobrachium polycotylum*, Meisenheimer.
- *Cliopsis krohni*, Troschel.
- *Clione antarctica*, E. A. Smith.
- *Thliptodon gegenbauri*, Boas.
- *Thliptodon diaphanus*, Meisenheimer.

EUPTEROPODA (THECOSOMATA)

The Eupteropods owe their name to the development of the anterior lateral portions of the foot into wing-like fins. These are placed at the sides of the mouth, which is always on the anterior portion of the ventral surface. The lips of the mouth are covered with vibratile cilia. Nearer the dorsal surface are a pair of tentacles (rhinophores) which are generally unequal in size, the left being often knob-like, while the right, five to twenty times longer, is usually cylindrical, rounded at the end and capable of being withdrawn into a sheath. In *Peraclis* and in the Cymbuliidae, however, both tentacles are rudimentary and similar in size. The penis is near the tentacles, towards the right. The fins are separated dorsally, but are joined ventrally by a median lobe, which forms the posterior part of the foot and is known as the apron. In the genera *Cleodora*, *Creseis* and *Cuvierina* the fins are bilobed, while in *Cavolinia*, just near the junction of the fin with the apron, there is a suggestion of another lobe. A large mantle covers the viscera, and the pallial cavity is placed ventrally in the Cavoliniidae and dorsally in the Limacinidae and Cymbuliidae. Fol (1875) has shown that torsion takes place in the arrangement of the viscera during the development of the Cavoliniidae before the formation of the shell, so that the entire visceral mass, but not the head, the nervous ganglia and penis, is turned from right to left. On account of this the penis and genital duct open on the right in the Limacinidae and on the left in the Cavoliniidae, except the penis which remains on the right side. *Cavolinia* has also long lateral posterior appendages to the mantle which pass through slits in the shell.

All Cavoliniids have a "balancer" at the left side of the mantle, and inside the mantle margin, on the ventral side of the body, is a small membranous lobe which constitutes a rudimentary gill. The gill is absent in *Diacria*, *Cleodora*, *Cuvierina*, *Limacina*, and *Cymbulia*, but is well specialized in the genus *Peraclis*.

The shell in all Eupteropods is very fragile and more or less transparent. In the Cavoliniidae it is symmetrical and not coiled. The upper side has fine longitudinal ribs: the lower side is much swollen and striated transversely. The digestive apparatus (throughout the group) consists of a long tube with buccal bulb and salivary glands, and a swollen gizzard, containing four large corneous, hyaline plates and one small one. These plates are so large and many-angled that their outline shows clearly through the brown skin and the numerous transverse muscle bands. There are also a number of small chitinous pieces. The intestine has a small caecum. The liver pancreas is not attached to the stomach, as in the Gymnosomata. The genital gland adheres closely to the posterior part of the liver pancreas. It varies in shape so as to fit the space allotted to it by the shell, being conical in *Creseis* and round in *Cavolinia*. The hermaphrodite genital duct is always very long. The jaws are always placed ventrally and are not much developed. The radula is three-toothed, except in *Peraclis*, where there is an extra, but very rudimentary, lateral tooth on each side of the series of three [(1) 1–1–1 (1)].

The nervous system includes two cerebral ganglia united below the oesophagus by a long commissure, two pedal ganglia and from one to five visceral centres. There are no pleural ganglia. The otocysts are attached to the cerebral ganglia between these and the visceral mass. The olfactory organ (Osphradium, Spengel's organ) is placed close to the otocysts. Eyes are completely absent. Bonnevie (1913, p. 52), however, has suggested that the curious white plates which are so conspicuous on the top of the tentacles in *Cleodora falcata*, Pfeffer, and *Limacina helicoides*, Jeff., may be organs of light production or light perception. Vayssière (1915, p. 190) says: "J'ai pu confirmer l'absence absolue des organes visuels chez tous ces mollusques, il n'y en a pas méme de très rudimentaires comme cela s'observe chez d'autres Tectibranchs tels que les Philinidés et les *Scaphander*."

The large pallial cavity contains the organ of Bojanus, or paired kidney, the heart, and also the gills, where these are developed.

All Eupteropods are phosphorescent. The food is wafted to the mouth by the cilia and consists chiefly of Diatoms, Radiolaria and Foraminifera and occasionally of the larvae of Copepods and other small Crustacea or even very young Eupteropods.

Family CAVOLINIIDAE

Genus Cavolinia, Gioeni, 1783

Cavolinia longirostris (Lesueur), 1821.

Hyalaea longirostris, Lesueur (after Blainville), 1821.
Hyalaea limbata, d'Orb., 1836.
Hyalaea angulata, Souleyet, 1852.
Hyalaea fissirostris, Benson, 1861.

St. 279. 4 mm. mesh net at back of trawl: 6 shells.
St. 288. Young-fish trawl, 250 (–0) m.: 3 specimens; 1 m. tow-net, oblique, 73–0 m.: 1 specimen.

The specific name of this species is taken from the long upper lip of the dorsal side of the shell. It is one of the very few species which a beginner might venture to name from the written description of the shell, as it is the only species with a shell of a triangular shape when fully developed. At this stage the posterior "thorn" is always wanting and the lateral points of the ventral side project in triangular-shaped portions beyond the slits on the upper side. Boas (1886, p. 102) mentions that the smallest shells which came under his observation (from Chinese seas) measured 2·5 mm. and the largest (from the Atlantic) measured 9 mm. The specimen from St. 288 measured 7 mm.

Distribution. This species is known from 40° N (Schliemenz, 1906, p. 20), and occurs in all seas between 40° N and 40° S. It is very abundant in Indian and Chinese seas and off the Great Belt of Australia.

Cavolinia gibbosa (Rang), in d'Orb., 1836.

Hyalaea flava, A. d'Orb., 1836.
Hyalaea gegenbauri, Pfeffer, 1880.

St. 87. Young-fish trawl, 1000 (–0) m.: 3 shells.
29° 27′ 00″ N, 15° 07′ 00″ W. 2 m. net, 900 m.: 24 specimens.

The fins of this species are generally trilobed, the apron is well developed and the lateral appendages to the mantle are very long. The shell is very globular and has a rounded upper lip measuring about one-seventh of the length of the shell when viewed from above. It curves down over the mouth. The lateral points are very short and the distance between them is considerably less than the breadth of the shell in the middle. The posterior "thorn" is bent like a fish hook.

The twenty-four specimens recorded from off the Canary Islands were taken from the stomach of *Naucrates*.

Distribution. Cosmopolitan except at the poles. Although a warm-water species it avoids the immediate neighbourhood of the equator.

Cavolinia inflexa (Lesueur), 1812.

Hyalaea inflexa, Lesueur, 1812–13.
Hyalaea depressa, d'Orb., 1836.
Hyalaea inflexa and *labiata*, Souleyet, 1852.
Hyalaea vaginellina, Cantraine, 1840; Gegenbaur, 1855.

St. 80. Young-fish trawl, 1000 m.: 1 specimen.
St. 87. Young-fish trawl, 1000 (–0) m.: 2 specimens.
St. 89. 2 m. net, horizontal, 180 (–0) m.: 8 specimens.
St. 268. 1 m. net, oblique, 73–0 m.: ? 2 young specimens.
2° 20′ 00″ S, 12° 45′ 00″ W. 1 m. net on trawl: 1 specimen.

This species has trilobed fins and neither apron nor lateral appendages are much developed. The shell is easy to distinguish from that of the other species, as the longitudinal ribs on the upper valve are almost effaced and the lateral points which form its greatest width are placed towards the centre, whereas in the other species of *Cavolinia* they are nearer the posterior end. The upper lip, when viewed from above, projects forward about as much as that of *C. longirostris*, but curves slightly upwards instead of over the lip. It is also rounder laterally and the edge is serrated. The posterior "thorn" curves upwards over the dorsal side. The lower side is not nearly so globular as in other members of the genus and the lip is developed rather strongly. The specimens from stations 80 and 89 measured 6–7 mm. in length.

Distribution. In all seas between about 40° N and about 40° S latitude. Exceptionally it wanders with a warm current as far as 50° N (Massy, 1909).

Cavolinia tridentata (Forskål), 1775.

Anomia tridentata, Forskål, 1775.
Hyalaea affinis, d'Orb., 1826–33.

St. 78. Young-fish trawl, 1000 (–0) m.: 1 specimen.
St. 85. 4·5 m. net, 2000 (–0) m.: 1 specimen.
St. 86. 4·5 m. net, 1000 (–0) m.: 13 specimens.
St. 89. Young-fish trawl, 1000 (–0) m.: 1 specimen.
St. 244. 1 m. net, horizontal, 55 m.: 4 specimens.
St. 288. Young-fish trawl, 250 (–0) m.: 1 specimen.
St. 289. Young-fish trawl, 125–225 (–0) m.: 1 specimen.
St. 294. 1 m. net, horizontal, 55 m.: 4 specimens.

Six of the above hauls were made off the African coast from the Gulf of Guinea to the Cape. The remaining two were west of Tristan da Cunha. This comparatively large species occurs in all warm seas. The specimen from St. 85 had a shell measuring 15 mm. in length and appeared to be a form between the type and var. *truncata*, Boas. This variety "se montre dans la partie la plus méridionale de l'Atlantique et la partie occidentale de l'Océan Indien" (Boas, 1886, p. 212). The same author (*loc. cit.*, p. 211) mentions that examples of this species in the Eastern Pacific are smaller (9–13 mm.).

The specimens from St. 294 possessed fins of a greenish hue.

Cavolinia uncinata (Rang), in d'Orb., 1836.

Hyalaea uncinata, Rang, 1836.
Hyalaea uncinatiformis, Pfeffer, 1880.

St. 273. Young-fish trawl, 200–230 (–0) m.: 3 specimens and 1 shell.
St. 276. Young-fish trawl, 150 (–0) m.: 5 specimens.
St. 279. 4 mm. mesh net on trawl, 58–67 m.: 8 shells.
St. 288. Young-fish trawl, 250 (–0) m.: 11 specimens; 1 m. tow-net, oblique, 73–0 m.: 2 specimens.

The above, which measured 6–7 mm. in length, were all caught off the Gulf of Guinea and the Congo river. The species is generally distributed in tropical and subtropical waters. Boas (1886, p. 120) mentions having seen a specimen of 11 mm., but states that the usual size is 7 mm. The most closely allied species is *C. tridentata* (Forsk.), from which it is easily distinguished by the lateral points of the shell being longer, the upper lip more turned downwards, and the posterior "thorn" curved more upwards. The lower side is also more deeply sculptured.

Diacria, Gray, 1842

Diacria trispinosa (Lesueur), 1821.

Hyalaea trispinosa, Lesueur (in Blainville, *Dictionn. d'Hist. Nat.*, XXII, p. 82), 1824.
Hyalaea muronata, Quoy and Gaimard, 1827.

St. 89. Young-fish trawl, 1000 (–0) m.: 3 specimens.
St. 101. 4·5 m. net, 350–400 (–0) m.: 5 specimens.
St. 268. 1 m. net, oblique, 73–0 m.: 3 specimens.
St. 279. 4 mm. mesh net on trawl, 58–67 m.: 1 shell.
St. 288. Young-fish trawl, 250 (–0) m.: 9 specimens; 1 m. net, oblique, 73–0 m.: 3 specimens.

The above hauls were all made off the African coast from Cape Town to the Gulf of Guinea. Some of the specimens had hydroids on the shells. The average length was 8 mm. This genus is distinguished by having bilobed fins, a very large apron and neither gill nor lateral appendages. It resembles *Cavolinia* in the form of jaw, radula and gizzard plates, and in the rest of the internal organization. The posterior end of the shell is prolonged three or four times as much as in *Cavolinia*, and is almost straight instead of being bent. It terminates in a little knob, similar to the embryo shell in this position in *Cleodora*. The lateral points are also very long, are placed at about the centre of the shell and constitute its greatest breadth. They occupy about two-fifths of this measurement. The hinge is not nearly so well defined as in *Cavolinia*. The shell is chiefly transparent, but a chocolate-brown tinge is usually distributed in the region of the lip. The lower side is not much swollen.

DISTRIBUTION. Universal except at the poles.

Genus **Cleodora**, Péron and Lesueur, 1810

Cleodora sulcata (Pfeffer), 1879.

Cleodora sulcata, Pelseneer, 1888; Eliot, 1907.

Over 2000 specimens were caught in hauls made at thirty-four stations at the South Sandwich Islands at soundings of 0–250 m. A few occurred also at South Georgia and between the Falkland Islands and South Georgia at soundings of 0–500 m.

The specimens measured 2–30 mm. in length. The usual length of large individuals is 16–18 mm. With fins fully extended the length may reach 25–30 mm. The fins and apron are generally white, but in hauls made in January and February 1928, at the South Sandwich Islands (Sts. SS 34, 35, 52, 54 and 58) these portions of the body had a border of chocolate-brown which sometimes spread all over the fins on both sides. The tint became paler as the distance from the margin increased. Individuals in which the animal was in a peculiar soft condition, appearing to show degeneration in the cells, occurred at the South Sandwich Islands (Sts. SS 7, 9, 10, 14, 22 and 45).

The genus *Cleodora* has bilobed fins and a small cephalic lobe. The pallial lateral appendages are rudimentary. The shell is rhomboid in shape when viewed from above. The present species owes its name to the distinct transverse furrows on the shell, of which there is scarcely a trace in the nearly allied *C. pyramidata* (L.). Other differences are that the fins are shorter and their edges usually undulated. The apron is larger. The teeth are not serrated, the median tooth is narrower and the lateral teeth have broader bases. The dorsal side of the shell has five longitudinal ribs of which the median is the strongest. It extends into a point posteriorly and terminates in an oval swelling which represents the embryo shell. The ventral side is not much swollen and a triangular-shaped portion of the upper valve is visible above it. The anatomy of the Terra Nova specimens has been described (Massy, 1920, figs. 3–6).

DISTRIBUTION. Antarctic to about 50° S in the Indian Ocean and 46° S in the Pacific (Meisenheimer, 1905). From 5° S of New Zealand to far within the Antarctic Circle (Massy, 1920).

Cleodora pyramidata (L.), 1767.

Hyalaea lanceolata, Lesueur, 1913.
Cleodora exacuta, Gould, 1852.
Cleodora labiata, Sow. (in Reeve, *Conch. Iconica*), 1877.
Cleodora lamartinieri, Rang (in d'Orb., *Mollusques de Cuba*), 1841.

St. 81. 4·5 m. net, 650 (–0) m.: 18 specimens.
St. 87. Young-fish trawl, 1000 (–0) m.: 21 specimens.
St. 88. 1 m. net, horizontal, 3000–0 m.: ? 1 specimen.
St. 101. 4·5 m. net, 1310–1410 m.: 2 specimens.
St. 239. 4·5 m. net, 1050–1350 (–0) m.: ? 2 specimens.
St. 288. 1 m. net, oblique, 73–0 m.: 1 specimen.

The above specimens measured 5–12 mm. in length. The shells were in very poor condition, but the specimen from St. 288 appeared to belong to var. *lata*, Boas. This author (1886, p. 72) thus defines the distribution of var. *lata*: "Atlanterhavet fra *c.* 40° N Br. til henved 30° S Br. (Middelhavet), Indiske Ocean (fra dettes Nordgraense til *c.* 24° S Br.), Kinesiske Hav, Vestlige Stille Hav". Three of the hauls were made west of Cape Town, and the remaining three were made to the north of Ascension Island, to the north of Tristan da Cunha and to the north-west of the Falkland Islands. The species is cosmopolitan in warm and temperate seas.

Cleodora cuspidata, Bosc, 1802.

Cleodora cuspidata, Quoy and Gaimard, 1833.
Cleodora Lessonii, Rang, 1830.
Cleodora cuspidata (Bosc), 1802.

St. 78. Young-fish trawl, 1000 (–0) m.: 1 specimen.
St. 81. 4·5 m. net, 650 (–0) m.: 8 specimens; 1 m. net, 90 (–0) m.: 4 specimens.
St. 87. Young-fish trawl, 1000 (–0) m.: 4 specimens.

St. 89. Young-fish trawl, 1000 (–0) m.: 4 specimens.
St. 276. Young-fish trawl, 150 (–0) m.: 2 specimens.
St. 288. 1 m. net, oblique, 73–0 m.: 1 specimen.
13° 25′ 00″ N, 18° 22′ 00″ W, 4·5 m. net, 900–0 m.: 1 specimen.

The above hauls were made north of Tristan da Cunha and from Cape Verde to Cape Town.

The animal of this species is very like that of *C. pyramidata* (L.). The shell is extremely fragile and transparent when fresh. It differs from all the other species by the extreme length of the lateral points, which start from below the middle of the shell. The dorsal side has a strong median keel which projects forward in a point anteriorly. The posterior end is curved over the back and terminates in the rounded embryo shell. There are two longitudinal ribs on either side of the median keel and strong transverse furrows are present on both sides of the shell.

DISTRIBUTION. Mediterranean (Boas, 1886, p. 83). Atlantic (exceptionally to 59° N) and Indian Oceans: Antarctic (Meisenheimer, 1906). South-west Ireland (Massy, 1909).

Cleodora balantium, Rang, 1834.

Hyalaea balantium, d'Orb., 1826–33.
Balantium recurvum, Sow., 1877.

St. 276. Young-fish trawl, 150 (–0) m.: 2 specimens.
St. 286. Young-fish trawl, 125 (–0) m.: 4 specimens.
St. 287. Young-fish trawl, 800–1000 (–0) m.: 2 specimens.
St. 288. Young-fish trawl, 250 (–0) m.: 5 specimens; 1 m. net, oblique, 73–0 m.: 1 specimen.
St. 294. Young-fish trawl, 100–150 (–0) m.: 2 specimens.
St. 297. Young-fish trawl, 200–300 (–0) m.: 1 specimen.

All the specimens were caught between Cape Verde and the Congo river. They measured 8–29 mm. Hydroids were present on the shells in four of the hauls.

Although widely distributed this appears to be a rare species everywhere. The shell has no lateral points and the upper and lower lips project very slightly in the centre. The upper surface has three strong longitudinal ribs and transverse furrows. The lower side of the shell is swollen and prominent.

DISTRIBUTION. Atlantic (Boas, 1886). Indian Ocean (Boas, 1886). Pacific (d'Orbigny, 1847). North of New Guinea (Challenger Expedition).

Cleodora falcata, Pfeffer, 1880.

Clio polita, Pelseneer, 1888; Meisenheimer, 1905.

St. 71. Young-fish trawl, 2000 (–0) m.: 1 specimen.
St. 85. 4·5 m. net, 2000 (–0) m.: ? 1 specimen.
St. 89. Young-fish trawl, 1000 (–0) m.: ? 1 specimen.
St. 239. 4·5 m. net, 1050–1350 (–0) m.: 2 specimens.

All these specimens were in very bad condition and showed no traces of shells. Three were captured north-east of the Falkland Islands, and the two to which a query is attached were taken west of Cape Town. Vayssière (1915, p. 83) regards *Cleodora chaptali*, Souleyet, *C. andreae*, Boas, and *C. falcata*, Pfeffer, as synonymous with *C. curvata*, Souleyet. The latter species was named from a single individual 2 mm. in length having a perfectly smooth shell. The species recorded here is the same as that referred by Meisenheimer (1905*a*), Massy (1909) and Bonnevie (1913) to *C. falcata*, which is characterized by a dark purple body and a head which has the shape of a triangular lobe. The fins have a continuous margin. The tentacles have ivory-coloured end-plates: the right is the larger and is placed more anteriorly. The pallial cavity is placed ventrally, but extends also to the right side. The tongue-shaped gill is also on the right side, and the heart and kidney are placed ventrally. The shell is 2·5 times as long as broad. The ventral side has four shallow longitudinal furrows which are entirely absent from the dorsal side. On neither side is there a median projection of the lip of the shell. Lateral keels are present, and the posterior end is bent dorsally and terminates in the round embryonic shell usual in the genus. The type specimen measured 12·5 mm. in length.

Cleodora andreae, Boas, has a shell in which the length is 1·5 times the breadth. The dorsal side has five longitudinal ribs and the ventral side two. Very weak transverse furrows are present. Length 20 mm. A single individual was taken in the South Atlantic at 33° 30′ S, 11° 0′ W.

C. chaptali, Souleyet, is described from a single example 19 mm. in length taken at the Cape. The shell, according to Boas (1886, p. 81), is not so flat and is much broader than that of *C. andreae*. It has five longitudinal ribs on the dorsal side and the transverse furrows are more strongly marked than in *C. andreae*.

Of *C. curvata*, Souleyet, Boas (*op. cit.*) states that "It has the same general form as *C. chaptali* but is quite smooth, the mouth is narrower and the posterior end is bent upwards strongly. It is not the young of one of the foregoing species; if that were so its shell would be similar to the most posterior 2 mm. length portion of the shell of the species concerned, which is never the case. Souleyet took a single example in the Atlantic Ocean".

DISTRIBUTION. 44° N, 32° W, one. "Atlantic Ocean", one (Pfeffer, 1880). Davis Strait to 37° N (Meisenheimer, 1905). West of Ireland, 50° to 54° N, 400–1200 fathoms, four living (Massy, 1909). Empty shells, Azores, Canaries and South American coast (Challenger Expedition). North Atlantic only "in the deeper layers of the ocean" (Bonnevie, 1913).

Subgenus **Hyalocylix**, Fol, 1875

Cleodora (Hyalocylix) striata (Rang), 1828.

Hyalaea striata, d'Orb., 1826–33.
Creseis fasciata, Delle Chiaje, 1841.

St. 71. Young-fish trawl, 2000 (–0) m.: 1 specimen.
25° 47′ 00″ S, 14° 48′ 00″ W, hand-net: 2 specimens.

The specimen taken north-east of the Falkland Islands measures 12 mm. in length. Boas mentions that the largest he had seen measured 8 mm.

The subgenus *Hyalocylix* is chiefly distinguished from *Cleodora* by having no cephalic lobe. The tentacles are very unequal, the left being almost absent. The shell is hornshaped and fluted transversely and is slightly curved in the dorsal direction. The embryo shell is thimble-shaped, and as the animal grows this portion is separated by a partition and it breaks off eventually so that adult shells are always blunt posteriorly.

DISTRIBUTION. Although never abundant in large shoals, this is widely distributed in all tropical and sub-tropical seas.

Subgenus **Styliola**, Lesueur, 1825

Cleodora (Styliola) subula (Quoy and Gaimard), 1827.

Cleodora (*Creseis*) *spinifera*, Rang, 1828; Sow., 1877.
Hyalaea subula, d'Orb., 1836.
Cleodora subulata, Souleyet, 1852.

St. 80. 2 m. net, 30–0 m.: 1 specimen.
St. 87. Young-fish trawl, 1000 (–0) m.: 3 specimens.
St. 89. Young-fish trawl, 1000 (–0) m.: 1 specimen.
St. 287. Young-fish trawl, 800–1000 (–0) m.: ? 2 specimens.

Three of these hauls were made off the African coast from the Gulf of Guinea to Cape Town. A single specimen was taken north of Tristan da Cunha. The largest examples were 10–12 mm. in length. This is a warm-water species, but it apparently avoids the very warm water at the equator. In this subgenus the animal has a very distinct cephalic lobe. The shell is horn-shaped and easily recognized by the longitudinal furrow along the dorsal side, which is so deep as to form a ridge in the interior. It has transverse striae and microscopic longitudinal striae, and it is not curved. The embryo shell is persistent and not separated by a partition.

Genus **Cuvierina**, Boas, 1886

Cuvierina columnella (Rang), 1827.

Cleodora obtusa, Quoy and Gaimard, 1824.
Cuvieria urceolaris, Mörch, 1850.
Triptera columnella and *cancellata*, Pfeffer, 1879.

St. 80. 2 m. net, 30–0 m.: 1 specimen.
St. 84. Tow-net on dredge, 2000–0 m.: 1 specimen.
St. 85. 4·5 m. net, 2000 (–0) m.: 1 specimen; 2 m. net, 900–0 m.: 1 specimen.
29° 27′ 00″ N, 15° 07′ 00″ W, 2 m. tow-net, 0–900 m.: 1 specimen from stomach of *Naucrates ductor*.

The above were taken north of Tristan da Cunha and between that island and Cape Town. They measured 7–11 mm. in length. This species is abundant in the warm waters of the Atlantic, Indian and Pacific Oceans. Boas (1886, p. 131) explains why the name *Cuvieria*, given by Rang, cannot be used. The genus is characterized by having a body which is rounded posteriorly. The cephalic lobe is rudimentary. The right tentacle is much longer than the left. The radula has a median tooth with an almost rectangular base, with a breadth twice its length. The cusp, dentate only on the upper sides which slope towards the anterior corners of the base, is much more powerful than in the two species last mentioned. The lateral teeth are much smaller in proportion and have very short cusps with denticles varying in number from about seven to seventeen. The apron is broad, but so narrow as to show the mouth. The shell is at first cylindrical and terminates in a point. The pointed portion is separated from the rest of the shell by a partition: it is easily broken off, but, when perfect, forms one-third of the length of the shell. The latter is transparent and finely striated both longitudinally and transversely. The widest part is about at the centre of a complete shell, instead of being at the mouth as in *Cleodora*. Just below the mouth the shell is slightly constricted and, as the under-side is somewhat hollowed out anteriorly, it follows that the mouth is kidney-shaped rather than circular.

C. urceolaris, Mörch, is regarded by Boas and Vayssière as a variety of *C. columnella*. It is found in the Pacific and is characterized by having a smaller shell which is more swollen posteriorly and less drawn out anteriorly, and the neck is scarcely indicated.

Vayssière (1915, p. 107) mentions having examined specimens from New Caledonia and found their organization to be similar to that of the typical variety of the Atlantic.

Family LIMACINIDAE

Genus Limacina, Cuvier, 1817

Limacina helicina (Phipps), 1773.

Argonauta arctica, O. Fabr., 1780.
Limacina arctica, Möller, 1841.
Limacina antarctica, Woodward, 1856; Pelseneer, 1887; Eliot, 1907.

Extremely numerous in the seas surrounding South Georgia and the South Sandwich Islands. No fewer than 5706 specimens were collected at seventy-eight stations in this area.

All the specimens were taken during the Antarctic summer, two-thirds of the hauls being made in December and January. The largest shoals were taken at South Georgia, and at night. On one occasion (St. 136) 2074 specimens, measuring 3–5 mm., were caught. In all cases the measurements are those of the diameter of the body coiled up, and not with fins extended. The diameter varied from 1 to 6 mm. Most of the specimens had lost their shells, and opercula were usually present only in very young individuals. One example of 3 mm. diameter was, however, observed with an operculum. This is oval, with only one turn in the spire. A small gelatinous mass was taken in a December haul, at the South Sandwich Islands (St. SS 31), which contained a number of vertical white lines each measuring *ca.* 1 mm. in length. Each line contained 10–12 eggs touching one another. At St. 136, also in December, a specimen of *L. helicina* with an injured gonad showed similar eggs. Spawning specimens were taken in the month of January, in the Terra Nova Expedition (Massy, 1920). Although the largest haul was made at night, heavy catches occurred in the day also. Paulsen, in his plankton investigations in the waters round Iceland, in 1904, has pointed out that the difference between day and night is but slight in the Arctic summer, and he found that Pteropods at Iceland were able to stand daylight and moreover lived on organisms which were dependent on the daylight.

About one hundred examples from St. 133 from hauls at 50 and 100 m. had pink bodies. Usually the colour is dirty white, the liver and gonad being darker and more variable, while the region about the mouth is very dark.

Most of the species of this family are very small and have a sinistral shell with a spire more or less developed and a horny operculum, which may be circular or oval. *L. helicina* was described by Phipps nearly 160 years ago under the name of *Clio helicina*. Arctic specimens are thus described by Sars (1878, p. 399): "Animal atro-purpureum vel obscure violaceum, alis pallidioribus, pellucidis". In the Terra Nova collection of 27,000 individuals from the Antarctic, the colour of the body of the animal was found to be lemon-yellow in small specimens, fawn turning brown in larger, and dark brown in all specimens above 2·5 mm. in diameter (Massy, 1920). The shell is very thin and has a low spire of about five or six whorls, with a deep suture. The surface is closely furrowed and the shell can reach 8 mm. in size (Meisenheimer, 1905, p. 410).

Sir C. Eliot (1907, p. 7) found six points of difference between specimens taken by the 'Discovery' in Antarctic waters, which he regarded as *L. antarctica*, and a large collection of *L. helicina* from Davis Strait and the North Pacific.

(1) Antarctic specimens were smaller and the fins were smaller in proportion to the size of the shell. I have found Antarctic specimens, varying in size from 0·5 mm. to 6·0 mm. in diameter, and the fins seem to be very variable in size, some being much longer and thinner than others. Probably the state of extension at the time they were killed, and the degree of strength of the different kinds of preserving fluid, would also affect the fins and cause contraction or make them appear long-drawn out and flabby.

(2) and (3) Striation and umbilical border of shell. Most of the present specimens have lost their shells. In the Terra Nova examples shells with faint spiral striae but with no umbilical border were observed in specimens up to a size of 2·5 mm. Meisenheimer (1905, p. 410) found that the umbilical border was well marked only in adult specimens and was but feebly developed in specimens of about 3 mm. in diameter.

(4) Distribution of colour. As already noticed this would seem to vary with age from lemon-yellow to fawn, pink and dark brown.

(5) Posterior lobe of foot more deeply and distinctly divided. "In the Terra Nova specimens this is certainly the case compared with Boas (1886), fig. 70 of Table 5, but the figures of Vayssière (1915, pl. vii, figs. 135*a* and 136) of the examples of *L. helicina* from Spitsbergen which he has studied, closely resemble many of the specimens in the present (Terra Nova) collection" (Massy, 1920).

(6) Variations in the teeth. Sir C. Eliot found the base of the median tooth in *L. antarctica* to be straight, while in *L. helicina* it was almost horse-shoe shaped. I have found that this character is dependent upon the position which the tooth happens to take when being mounted. Even in the same specimen the median tooth can exhibit both these forms.

DISTRIBUTION. Coasts of Norway (Sars, 1878). Spitsbergen (Vayssière, 1915). Nova Zembla, White Sea (Meisenheimer, 1905). Greenland, Iceland, Labrador; North Pacific to California as *L. pacifica*, Dall (Boas, 1886, p. 42). In southern regions, where Vayssière (1915, p. 124) thinks it has been accidentally introduced by marine currents, it has been observed as far north as 35° to 31° S (Meisenheimer, 1905).

Limacina balea, Möller, 1841.

Spirialis Gouldii, Stimpson, 1851.
Heterofusus balea, Mörch, 1857; Gould, 1870.

237 specimens identified with certainty, and 16 which appear to belong to this species, from stations in the neighbourhood of South Georgia and the South Sandwich Islands.

This species was taken in practically the same area as *L. helicina*, namely, the water enclosing South Georgia, and the South Sandwich Islands, roughly from 52° S to 62° S latitude, and from 20° W to 40° W longitude. Two very small specimens were taken a few degrees further north (St. 11). The largest specimens have a spire of five or six whorls. In all the spire is higher in proportion to the width of the last whorl than is the case in *L. retroversa* (Fleming). Spiral striae were not observed on any of the shells. The specimens were usually taken in small numbers, but in four hauls made at the end of May 1927 off Cumberland Bay, South Georgia, catches of fifty to two hundred occurred. The other hauls were made from November to March. Boas (1886, p. 44) states that his largest specimen measured 5·5 mm. in length and the shell had ten whorls. It was finely striated spirally and transversely. Boas (*op. cit.*) and Vayssière (1915, p. 143) regard *L. retroversa* (Fleming) as the same species as *L. balea* and consider that the various differences noted in the shell are due to differences of age. In support of this view I may mention that all the specimens I have seen of *L. retroversa* are smaller than *L. balea*. On the other hand, both in the present collection and in that made by the 'Terra Nova', the two forms were not taken together. The localities were indeed widely separated.

DISTRIBUTION. Temperate zones between Arctic and Antarctic and circumtropical zone (Bonnevie, 1913).

Limacina retroversa (Fleming), 1828.

Heterofusus retroversus, Fleming, 1828; Gould, 1870.
Atlanta trochiformis, d'Orb., 1835–47.
Spirialis flemingii, Forbes and Hanley, 1850.

Two specimens were picked out from a haul north-east of the Falkland Islands (St. 68).

DISTRIBUTION. Atlantic and Pacific in warm and temperate seas (Bonnevie, 1913). Mediterranean, British Isles, and occasionally off Norway (Sars, 1878).

Limacina helicoides, Jeffreys, 1877.

St. 8. 2 m. net, 600–700 m.: 1 specimen.
St. 71. Young-fish trawl, 2000 (–0) m.: 1 specimen.
St. 87. Young-fish trawl, 1000 (–0) m.: 1 specimen.
St. 89. Young-fish trawl, 1000 (–0) m.: 1 specimen.
St. 100 C. Young-fish trawl, 2500–2000 m.: 1 specimen.

Three of the above hauls were made west of Cape Town; the other two were made between Tristan da Cunha and the Falkland Islands. This is always a rare species and appears to belong to a water layer with temperature below 10° C. The animal is purple-black in colour and, as in *L. helicina*, the pigmented outer skin peels off very easily. Vayssière (1915, p. 136) thinks it probable that the body is reddish or violet when alive. The fins are oval and have a continuous margin without any lobe. The apron is not very large and carries a horny operculum with a spire of two turns, the last being 8–10 times wider than the first. The right tentacle is much larger than the left, and, as in *Cleodora falcata*, Pfeffer, both tentacles are surmounted by conspicuous ivory-coloured plates. One of the four large plates in the gizzard is always larger than the rest. The median and lateral teeth are proportionately of the same size. The median tooth is triangular, but the denticles are very irregular in shape and size. The genital gland is yellow, and the sac-shaped copulatory organ has a very long caecal prolongation. The shell is snail-shaped, opaque and dull orange in colour. It is composed of 3–3½ whorls and has very fine transverse striae.

This is the largest species of the genus. Vayssière (1915, p. 137) gives the transverse dimensions of the animal across the fins as 10–11 mm., and the size of the shell 4–9 mm. in diameter and 3–6 mm. in height.

DISTRIBUTION. "Several stations in the Atlantic, from off the British Isles to the Azores, always dead and at considerable depths" (Sykes, 1905). Atlantic, south of equator, along African coast, alive (Meisenheimer, 1905). South-west Ireland, alive (Massy, 1909). Western part of North Atlantic, 400–1500 m. (Bonnevie, 1913). North Atlantic off the Azores, four alive (Vayssière, 1915).

Limacina bulimoïdes (d'Orbigny), 1836.

Atlanta bulimoïdes, d'Orb., 1836.
Spiralis bulimoïdes, Eydoux and Souleyet, 1840.

St. 87. Young-fish trawl, 1000 (–0) m.: 20 specimens.

This is a small species, individuals measuring only 2 mm. in length with fins extended. The shell has a relatively high spire composed of five or six whorls, and measures 1–2 mm. in length. It is smooth and transparent, and generally of a dark horn colour. The operculum is oblong with an eccentric spire.

The species occurs in the warmer portions of all seas. It does not appear to have been taken farther north in the Atlantic than between Newfoundland and the Azores (Bonnevie, 1913). Mlle Bonnevie observed that most of the specimens had a bright red columnellar margin. Usually this is amber tinted (Vayssière, 1915, p. 141). It has been recorded from the eastern Pacific and from Chinese seas to 40° N and 170° W (Boas, 1886).

Genus **Peraclis**, Forbes (emend.), 1844

Peraclis diversa, Monterosato, 1884.

Spirialis diversa (Monterosato), 1884.
Peracle diversa, Locard, 1897.
Peraclis bispinosa, Pelseneer, 1888.

St. 295. Young-fish trawl, 2500–2700 (–0) m.: 1 specimen.
6° 55′ 00″ N, 15° 54′ 00″ W, 2 m. net, 0–800 m.: 8 specimens.

The first of the above hauls was made off the Gulf of Guinea and the other to the north-east of Ascension Island.

The principal differences between this genus and *Limacina* are that *Peraclis* is characterized by having a well-specialized gill and a radula with rudimentary lateral teeth so that the formula is (1) 1–1–1 (1). A large cephalic lobe is developed, bearing rudimentary tentacles of equal size. The fins, which are broad and plate-like, have a continuous margin without lobes. A caecum appears to be absent from the intestine.

The present species has a shell with three whorls, the last of which is very wide. The suture has transverse folds. The surface of the shell is covered with a beautiful hexagonal network except on the last quarter or third, which is smooth. The outer lip is generally broken, but, if perfect, a third spine appears. The shell measures 8–9 mm. in length by about 6 mm. in width at the mouth. The sub-circular operculum has a spire of six turns.

DISTRIBUTION. Mediterranean. Atlantic. Bonnevie (1913) observed that this species was taken by the Michael Sars North Atlantic Expedition up to lat. 46° 58′ N, not among surface plankton, but mainly from a depth of *ca.* 1000 m., and its distribution was in conformity with the extension of a water layer with a temperature of *ca.* 6–8° C. and a salinity of 35–35·5 ‰.

Family PROCYMBULIIDAE

Genus **Procymbulia**, Meisenheimer, 1905

Procymbulia valdiviae, Meisenheimer, 1905.

St. 37. 1 m. tow-net, horizontal, 90 (–0) m.: 1 specimen.
St. 62. 1 m. tow-net, horizontal, 90 (–0) m.: 5 specimens.
St. 66. 1 m. tow-net, horizontal, 45 (–0) m.: 2 specimens.
St. 71. Young-fish trawl, 2000 (–0) m.: 7 specimens.
St. 72. 4·5 m. tow-net, 2000 (–0) m.: 1 specimen.
St. 78. Young-fish trawl, 1000 (–0) m.: 1 specimen.
St. 85. 4·5 m. tow-net, 2000 (–0) m.: 1 specimen.
St. 110. 1 m. tow-net, horizontal, 178 m.: 1 specimen.
St. 114. 4·5 m. tow-net, 650–700 m.: 1 specimen.
St. 238. 1 m. tow-net, horizontal, 148 m.: 2 specimens.
St. 239. 4·5 m. tow-net, 1050–1350 (–0) m.: 2 specimens.
St. WS 68. 70 cm. tow-net, vertical, 750–500 m.: ? 1 very young specimen.

Meisenheimer (1905, pp. 13–14) defines the characters of the genus *Procymbulia* as follows: "Dieses neue, eigentümliche Genus, welches als ein direkter Vorfahre der Cymbuliiden aufgefasst werden muss, zeigt die Merkmale der Familie nur insofern, als es eben noch eine aufgewundene Körperform besitzt, unterscheidet sich aber aufs schärfste von *Limacina* und *Peraclis* dadurch, dass seine Mantelhöhle nicht mehr dorsal gelegen ist, sondern bereits ventral verlagert erscheint. Von der Valdivia Expedition nur in einem einzigen Exemplar erbeutet, dessen Schale aufgelöst war.

"Schale unbekannt. Spirale des Körpers niedrig, die letzte Windung mächtig angeschwollen. Mantel. Mantelhöhle ventral gelegen, Mantelrand mit wohlentwickeltem Fortsatz 'balancer'.—Flossen zu einer einheitlichen, mächtigen Scheibe verwachsen, die am freien Rand einen unpaaren, medianen Fortsatz von stumpfer, lappenartiger Gestalt trägt. Zu beiden Seiten des letzteren sind 2 kleine, tentakelartige Zipfel inseriert. Rüssel. Mundabschnitt unter Umbildung der eigentlichen Fussteile zu einem Rüssel umgewandelt, von ähnlicher Form, wie ihn *Peraclis* aufweist. Tentakel symmetrisch, auf beiden Seiten gleich gross, ohne Scheide. Visceralganglien aus 2 eigentlichen Visceralganglien und einem unpaaren Abdominalganglion bestehend. Darmtractus. Mit spiralig aufgewundenem Enddarm und mit langem Aftersipho.

"*Procymbulia valdiviae*. Mit den Merkmalen des Genus. Die medianen Teile der Flossenfläche sowie die Mantelränder stark chokoladebraun pigmentiert. Oberkiefer und Radulazähne (1 : 1 : 1) mächtig entwickelt. Masse: Hohe der Spirale 5 mm., Flossenbreite 10 mm. Fundort, Stat. 169 (34° 14′ S, Br. 80° 31′ O. L.) etwas nördlich von der Neu-Amsterdam-Insel. Vert-Zug 2000 m. Oberfl. Temp. 17,1°; leicht bewegte See; 1 Exemplar."

The Discovery specimens show that this species is widely distributed in the South Atlantic from 55° S to 35° S and from off the Falklands to Bouvet Island and Cape Town. Twenty-five specimens occurred in the twelve hauls, seven of which were made over soundings of 700–2000 m. The type measured 10 mm. across the fins. In the present collection this measurement varies from 6 to 22 mm., but in the specimen to which a query is affixed it is only 3 mm. As in the type they are without shells. Possibly in this species the larval shell is retained in early life but does not persist. I make this suggestion because in the older specimens the coiled nucleus is enclosed in a firm membrane, and in the younger examples the nucleus is imperfect and more or less falling to pieces as if in need of protection. In some of the specimens which are flattened and in poor condition this coil is not distinguishable. Where distinct it is about in the position of the figure indicated by Meisenheimer (1905, pl. i, fig. 7), *i.e.* almost in a line with the lobe on the left fin; but occasionally, and particularly in young specimens, it appears to be almost in a line with the lobe of the right fin, and as the animal grows the nucleus shifts until it is under the middle of the mouth, and then almost under the lobe of the left fin. With regard to these lobes, they are so well marked in some specimens that they might easily be regarded as some kind of tactile organ. In a few specimens they are absent or indicated by a dark line on the fin surface, but are not separated by a fold or split from the flat surface of the fin. It does not appear to be a character dependent on age, as specimens with a fin breadth of 10–22 mm. possessed the lobes. In the most perfect specimens the outer edge of the fin takes a beautiful circular sweep and the white surface is bordered with purple-brown. The specimens from Sts. 62 and 239 had minute tubercles dotted all over the surface.

This little-known species was collected by the Valdivia Expedition in 34° 14′ 00″ S, 80° 31′ 00″ E, somewhat north of New Amsterdam Island.

Family CYMBULIIDAE

Genus **Cymbulia**, Péron and Lesueur, 1810

Cymbulia peroni, Blainville, 1818.

Cymbulia proboscidea, Gray, 1850.

St. 81. 4·5 m. tow-net, 650 (–0) m.: 3 specimens and 4 conchae.

St. 86. 4·5 m. tow-net, 1000 (–0) m.: 3 specimens with conchae.

St. 87. Young-fish trawl, 1000 (–0) m.: 1 specimen with concha.

St. 257. Young-fish trawl, 100–150 (–0) m.: 1 concha.

St. 268. Young-fish trawl, 100–150 (–0) m.: 13 specimens with 8 conchae; 1 m. tow-net, oblique, 73–0 m.: 17 specimens and 5 conchae; 1 m. net, horizontal, 73 m.: 4 conchae.

One of the above hauls was made north of Tristan da Cunha and the remainder between Elephant Bay, West Africa, and Cape Town. Some of the animals were still attached to their transparent slipper-like shells. A large specimen measured 30 mm. across the fins. The ventral lobe of the fin is transparent and strengthened by two muscle bands placed side by side, which become fused together in a point distally. The filament at the extremity, which is shown in Boas' illustration (1886, Tab. 3, fig. 30), was missing in all the specimens. The conchae measured 32–55 mm. in length. An exceptionally large concha (St. 257) measured 66 mm. in length by 28 mm. in diameter. Tesch (1904) has described a species of *Cymbulia* as *C. sibogae*, the deutoconch of which is characterized by the acute dorsal extremity, by the straight rows of denticles on the aboral surface, by its smaller size and shallower sinus at the ventral end. A concha from St. 86 had a pointed extremity but the sinus at the ventral end was V-shaped. When, however, the conchae are in poor condition and obviously beginning to dissolve away, they have a very thin acute dorsal extremity and no tubercles.

In this family, as in the last two genera, the tentacles are small and of equal size. The pallial cavity is situated dorsally and there is no gill. The fins are very large and are connected anteriorly with the proboscis and posteriorly with the apron. They are rather thick and opaque, except at the edges where the muscles can be seen. The mantle is thin and very extensive, and covers the transparent slipper-shaped deutoconch of horny substance, which protects the viscera. The deutoconch succeeds a calcareous spiral operculate larval shell. The jaws are not much developed. The radula, where present, has the formula 1–1–1. The gizzard contains four large and one small plate, as well as a number of very small chitinous pieces. Vayssière (1915, p. 173) says that the deutoconch or protecting organ may be considered as a simple thickening of the mantle analogous to the internal shell of certain Gastropods (Pleurobranchs, *Marsenia*). The anatomy of the present species has been very fully described by Vayssière (*op. cit.*, pp. 174–185).

Distribution. Mediterranean. Off South-west Ireland (Massy, 1909). Off Gibraltar to Bay of Biscay (Bonnevie, 1913). Gulf of Guinea (Meisenheimer, 1905).

Genus **Cymbuliopsis**, Pelseneer, 1888

Cymbuliopsis intermedia, Tesch, 1904.

St. 268. Young-fish trawl, 100–150 (–0) m.: 13 specimens and 2 conchae; 1 m. tow-net oblique, 73–0 m.: 3 specimens and 32 conchae; 1 m. net horizontal, 73–0 m.: 11 conchae.

St. 270. Young-fish trawl, 200 (–0) m.: 30 specimens and 11 conchae.

The genus *Cymbuliopsis* is distinguished from *Cymbulia* and *Gleba* "by the presence of a shell with a very large cavity and thin walls. The animal very closely resembles *Gleba*, having a proboscis free throughout its length, a fin without ventral lobe, and neither radula nor jaws. As far as I can judge, however, it differs from *Gleba* by the three very distinct muscular systems in the fin, and in the absence of the indentations on the fin margin. As only very few species of both these genera are known, it is very probable that other forms, not yet discovered, will link together the two types" (Tesch, 1904, p. 57). This author (*loc. cit.*, p. 59) describes the type specimen as follows: "The shell exhibits the usual characters of *Cymbuliopsis*. The aperture is always somewhat longer than half the length of the shell. In the distribution of the tubercles I could not observe any regularity; on the aboral surface are some which are smaller, more closely grouped together; at the ventral margin there are none (figs. 102, 104). This character of the shell agrees partly with what is found in *Cymbuliopsis vitrea*, Heath and Spaulding. Aperture unarmed, thickened lateral sides; these thickenings disappear towards the ventral margin. Tubercles at the oral surface sometimes fused into mere unevennesses, separated by shallow grooves. Animal as in other species of *Cymbuliopsis*; proboscis short and broad, tentacle very short; fins with three distinct systems of muscles; anterior border of the fins scarcely projecting beyond the ventral margin of the shell (almost as in *Cymbuliopsis calceola*); pallial gland twisted to the left, with three transparent bands. Dimensions: 39–23 mm. Shell of St. 144: 30 mm. Colour of the shell: generally transparent, sometimes yellowish, or even dark brown (alcohol- and formol-specimens)".

The forty-six specimens with fifty-six conchae recorded above were captured off Elephant Bay, West Africa. The animals measure 27–50 mm. across the fins and the conchae are 14–42 mm. in length. Only one individual and seven shells were taken by the Siboga Expedition.

The transparent fins are crossed and re-crossed by three sets of muscles, while the soft viscera are protected by the glassy slipper-like concha studded with knobs glittering like crystal. The specimens were preserved in formol and all the conchae were transparent, none showing the yellowish or dark brown tints observed in some of the Siboga conchae. With this exception the present specimens are in close agreement with the figures given by Tesch (1904, pl. iv, figs. 100–104).

A living specimen of this species was found by the Siboga Expedition near Damar Island, while conchae were taken at five stations lying between lat. 2° 3′ and 10° 35′ S, long. 117° 4′ to 131° 26′ E.

PTEROTA (GYMNOSOMATA)

The naked Molluscs which form this group among the Tectibranchs are not nearly related to the Pteropoda, but are allied to the Aplysioidea. Owing to their minute size and to the frequently contracted state of their bodies they are not easy to study. Only extended individuals of particular species measure more than an inch in length. The average size is about that of a grain of wheat and many are much smaller. The buccal appendages and gills vary in the different families and in contracted specimens can only be determined by dissection. There is no pallial cavity and no gizzard with plates. The liver-pancreas adheres to the stomach, and the cerebral ganglia are attached to one another instead of being united by a commissure. The radula has usually a number of lateral teeth. All the group are carnivorous and feed principally on the Thecosomata. Although a pair of fins would seem to be a necessity to their active life, abnormal specimens of *Pneumodermopsis paucidens* (Boas) have been observed (Massy, 1917, p. 231) in which only the right fin was developed in nearly all the specimens of a haul.

Family PNEUMODERMATIDAE

Genus Pneumoderma, Cuv., 1804

Pneumoderma atlanticum (Oken), 1816.

Pneumodermopsis atlantica, Oken, 1816.
Pneumodermon Peronii, Lamk., 1819 (*nec* Boas, Pels., Meis., Tesch).
Pneumoderma violaceum, d'Orb., 1840; Boas, 1886; Pels., 1888; Meis., 1898; Tesch, 1913.

St. 276. Young-fish trawl, 150 (–0) m.: 2 specimens.

Both these specimens were captured off the Congo river.

They were retracted, and measured about 6·5 mm. in length. The suckers and radula were examined.

The family Pneumodermatidae possesses a dorsal glandular patch; a lateral gill; sucker-bearing arms; a median jaw and hook sacs.

The genus *Pneumoderma* has two sucker-bearing arms, a posterior gill, long hook sacs, radula *n*-0-*n* in the adult, *n*-l-*n* in the young. The present species has a radula of 4-0-4 and the suckers on the arms are numerous; the largest are near the mouth and they become smaller distally. Mme Pruvot-Fol (1924, pl. xv, fig. 1) gives a fine illustration of a fully extended specimen with about 33–40 suckers on each arm. The synonymy of this, the oldest described species of the genus, is fully explained in the same paper.

Distribution. Atlantic, Pacific, Mediterranean.

Genus Spongiobranchaea, d'Orb., 1840

Spongiobranchaea australis, d'Orb., 1840.

Cliodita caduceus, Quoy and Gaimard, 1825.

113 specimens from thirty-five stations off South Georgia and the South Sandwich Islands.

The specimens of this species, which was taken in comparatively small numbers, vary in length from 0·75 mm. to 12 mm.: the Terra Nova specimens measured 2·5 to 16 mm. The largest haul (twenty-five examples) occurred at night. Two specimens were taken in hauls west of Cape Town, and two more occurred north-west of Tristan da Cunha. Two larvae of 1·5 mm. occurred at St. 12. They have the white body covered, as is usual in adults, with a dense speckling of black chromatophores. One had a sucker expanded and the other had the lateral gills developed. An example of 2 mm. from St. 138 has brown spots in zones. The larva of 0·75 mm. occurred with two older specimens at the South Sandwich Islands, in December (SS 15). In an individual measuring 12 mm. in length, taken off South Georgia (WS 37), the jaw and radula were of a bright scarlet colour. The animal had been preserved in 5 per cent. formalin. I have never previously seen any Molluscan radula other than of an amber tint. The specimen has been seen by Mme Pruvot-Fol, who also considers it to be very curious. In connection with this it may be mentioned that the columellar margin of *Limacina bulimoïdes* (d'Orb.) is usually amber, but specimens in which it was bright red were observed by Mlle Bonnevie in North Atlantic collections.

The genus *Spongiobranchaea* is characterized by having two sucker-bearing arms; a posterior gill consisting of a simple band without rays; a median tooth present in the adult; shallow hook sacs and a median jaw with numerous spines. The present species usually has about 7–10 suckers on each arm, of which those placed distally are much larger than one or two next the mouth. Usually, but not always, the animal is densely speckled with dark chromatophores.

DISTRIBUTION. Antarctic to about 50° S in the Pacific and in the Atlantic to about 36° S (Meisenheimer, 1905).

Spongiobranchaea intermedia, A. Pruvot-Fol, 1926 (Pl. XXXIX, figs. 1–5; Fig. 1).

St. 71. Young-fish trawl, 2000 (–0) m.: 1 specimen.
St. 72. 4·5 m. tow-net, 2000 (–0) m.: 1 specimen.
St. 239. 4·5 m. tow-net, 1050–1350 (–0) m.: 1 specimen.

Two of the above specimens have the sucker-bearing arms beautifully extended and measure 9–15 mm. in length. The other is 20 mm. long, but is a contracted specimen and probably measured much more when alive. As the type was a contracted specimen and possessed an incomplete median tooth, I sent these to Mme Pruvot-Fol who has most kindly examined them for me and thinks that they may be *S. intermedia* or a variety of the same. As she observes: "There are some important differences but the hook sacs are identical and the radula is the same or nearly so. The median tooth shows a 'contrefort' of an oval shape, two pointed denticles on each side, and a fold or suture without cusp in the middle line. This fold indicates the place where the two median teeth of the larva join to form one central tooth in the adult. It often breaks into two halves and I even think that one half sometimes persists in some rows, while the other disappears, this median tooth being inclined to disappear altogether as it does in the genus *Pneumoderma*. This fact explains the asymmetry of the tooth in my Monaco specimen."

Mme Pruvot-Fol has been so good as to send me drawings of the radula of the above specimens and also of the Monaco example for comparison (Fig. 1). The most important difference between the Discovery specimens and the type is that both Mme Pruvot-Fol and myself counted nearly eighty suckers on an expanded arm, whereas in the type only sixteen were counted; owing, however, to the type specimen being contracted, and the possibility that a few suckers had been lost during dissection, the number might have been twenty or more. As Mme Pruvot-Fol points out, there is great variability in these organs. It is a curious fact, too, that the suckers in the type (which measured 17 mm.

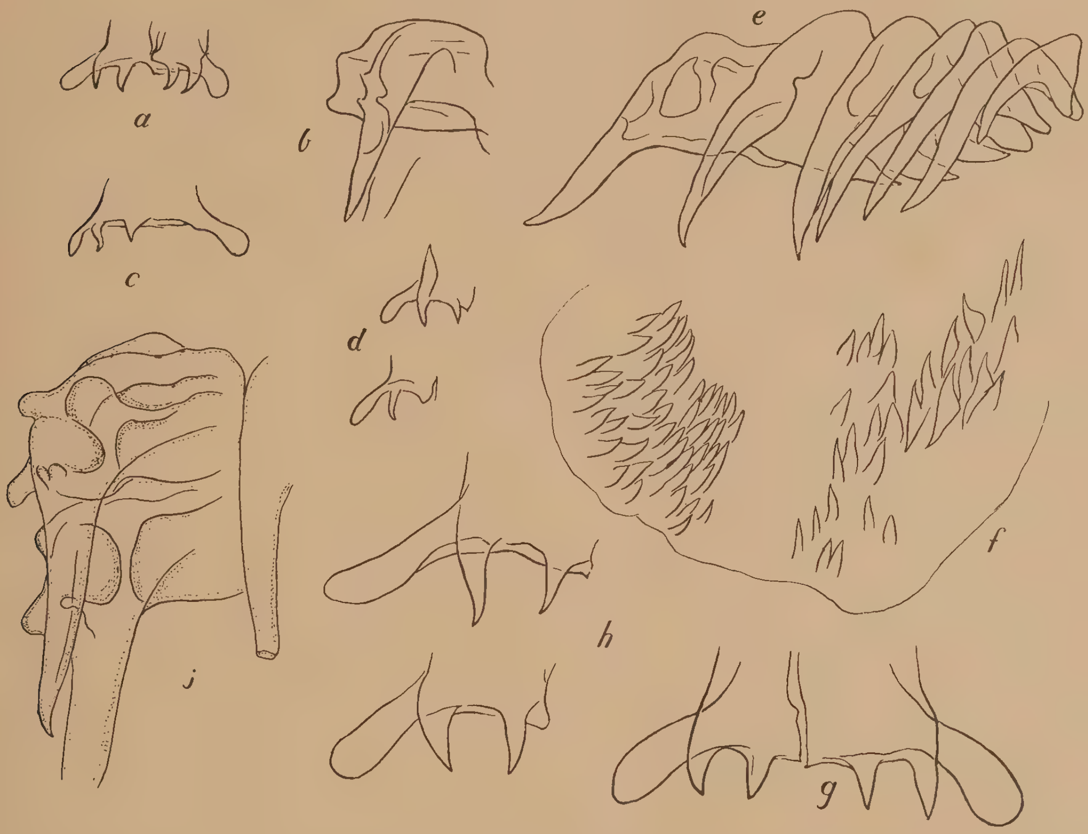

Fig. 1.

Spongiobranchaea intermedia, Pruvot-Fol. *a*, median tooth; *b*, first lateral tooth (from original Monaco specimen).

Spongiobranchaea intermedia var. *c*, median tooth on same scale as *a*; *d*, two median teeth (halves); *e*, lateral teeth, $\frac{1}{2}$ row; *f*, mandible; *g*, one median tooth; *h*, two median teeth (halves); *j*, the first lateral teeth of two rows. (Figs. *g*, *h*, *j* more highly magnified than preceding figures.)

and was estimated to have been 30 mm. or more when alive) were larger in proportion to the rest of the body than those of the present specimens. The branchiae of the three Discovery specimens are retracted and scarcely show in the illustrations, and they are as different from one another as they are from the type. The example from St. 71 has a sort of lateral gill which occupies the whole circle above the tail and seems to be longest in front, i.e. ventrally, which is strange.

The aspect of these animals varies extraordinarily according to the manner in which they have been prepared. When collectors preserve them without the use of anaesthetics, one can frequently do little or nothing with them. Mme Pruvot-Fol (1924, pl. xvi, figs. 1 and 2) has shown how different the appearance of *Pneumodermopsis canephora*, Pruvot-Fol, is when drawn from specimens fixed with and without anaesthesia. The ventral and dorsal aspect of the specimen from St. 72 and two enlarged suckers are shown on Plate XXXIX, figs. 1 and 2, and the contracted specimen from St. 239 is shown on the same plate in figs. 3 and 4.

DISTRIBUTION. 44° 19′ N, 11° 19′ W., 0–4900 m. (Pruvot-Fol, 1926.)

Genus **Schizobrachium**, Meisenheimer, 1905

Schizobrachium polycotylum, Meisenheimer, 1905.

St. 71. Young-fish trawl, 2000 (–0) m.: 1 specimen.
St. 78. Young-fish trawl, 1000 (–0) m.: 1 specimen.
St. 89. Young-fish trawl, 1000 (–0) m.: 1 specimen.
St. 107. 4·5 m. tow-net, 850–950 m.: 1 specimen.

The four specimens of this species were taken over a wide area in the South Atlantic and Southern Ocean, from 33° S to 45° S, and from north of the Falklands to between Bouvet Island and Cape Town. All have the branching sucker-bearing arms beautifully extended[1] and their total length is from 17 to 30 mm. Meisenheimer (1905, p. 51) defines the genus *Schizobrachium* as follows: "Körper langgestreckt, in der Mitte bauchig erweitert, am Hinterende zugespitzt. Auf der Rückenseite mit wohlentwickeltem Drüsenfeld. Fuss: Hinterlappen wohlentwickelt, abgestumpft. Seitenlappen mässig stark, ohne gefältelten Mittelhöcker. Kiemen: Seitenkieme geschwunden, Endkieme auf eine kleine Längsfalte an der Ventralseite des hinteren Körperendes reduziert. Saugnäpfe in sehr grosser Zahl 2 mächtigen, sich dichotomisch verästelnden Armen aufsitzend, an Grösse von der Basis der Arme bis zu deren feinsten Verästelung stetig abnehmend. Radula mit Mittelzahn. Hackensäcke äusserlich von bedeutendem, walzenförmigem Umfang, im Innern zum grössten Teile aus einer soliden Muskelmasse bestehend, in deren vorderem, nach der Mediane gewendeten Abschnitt die eigentliche Hackenscheide mit einer grösseren Zahl von Hacken gelegen ist. After auf der rechten Seite gelegen, ziemlich weit nach hinten verschoben. *S. polycotylum*. Mit der Merkmalen des Genus. Radula 7–1–7. Mittelzahn klein, mit 2 scharfen Spitzen. Seitenzähne mit starker Basalplatte und langem, spitzem Fortsatz, nach den Seiten an Grösse abnehmend. Masse: Länge des Körpers 32 mm., Breite 11 mm."

---

[1] These specimens were anaesthetized with cocaine.

Distribution. Indian Ocean, north of New Amsterdam Island, 2000 m. (Valdivia Expedition).

Genus **Pneumodermopsis**, Keferstein

Pneumodermopsis macrochira, Meisenheimer, 1905.

St. 89. Young-fish trawl, 1000 (–0) m.: 1 specimen.

This specimen, measuring 5 mm. in length, was taken west of Cape Town. The radula was examined.

The genus has a lateral but usually no posterior gill: the buccal appendages consist of three groups of suckers, hook sacs and radula *n*–1–*n*. *P. macrochira* has about forty suckers of equal size and a much larger terminal one on each lateral arm. Five stalked suckers take the place of the median arm. There is a very rudimentary posterior gill: the radula is 6–1–6, and there are about twenty hooks.

Distribution. Southern part of Atlantic and Indian Oceans (Meisenheimer, 1905). Ten stations in the North Atlantic, extending from the latitude between Bermuda and the west coast of Morocco to 48° 29′ N, 13° 25′ W (Bonnevie, 1913). Three stations on the west of Ireland, from 50° N to 51° N by 11° 26′ W to 11° 38′ W, over soundings of 625–990 m. (Massy, 1917). Two stations in the Atlantic from near the Canaries and between the Azores and the West Indies (Pruvot-Fol, 1926).

Family CLIOPSIDAE

Genus **Cliopsis**, Troschel, 1854

Cliopsis krohni, Troschel, 1854.

? *Cliopsis modesta*, Pelseneer, 1887.

St. 270. Young-fish trawl, 200 (–0) m.: 1 specimen.
St. 287. Young-fish trawl, 800–1000 (–0) m.: 1 specimen.

The specimens recorded above, measuring 9–12 mm. in length, were taken in hauls off Africa between Elephant Bay and the Gulf of Guinea. Mme Pruvot-Fol (1924, p. 363) thinks that *C. modesta*, Pels., should be placed in synonymy with *C. krohni*, at least until its radula is known.

The family Cliopsidae is distinguished by having no lateral gill and no median lobe to the foot. A dorsal glandular pit is present and there is generally a posterior gill. The skin is transparent and colourless or lightly tinted and opalescent. The head is small and the body swollen. The proboscis is extremely long: a jaw and shallow hook sacs are present: the radula has the formula *n*–1–*n*.

In *Cliopsis krohni* the gill consists of a hexagonal crest with four short unfringed rays: radula 6–1–6: hooks about sixty.

Distribution. Mediterranean, various authors. Western Mediterranean, especially to the west of Corsica and between Minorca and the African coast (Pruvot-Fol, 1924)

North Atlantic between the Azores and Bermudas, at 0–3000 m. (Pruvot-Fol, 1926). Yokohama to Honolulu, lat. 35° 13′ N, long. 154° 43′ W (Pelseneer, 1887, under *C. modesta*).

Family CLIONIDAE

Genus **Clione**, Pallas, 1774

Clione antarctica, E. A. Smith, 1902; Eliot, 1907.

Clione limacina var. *antarctica*, Meisenheimer, 1906.

206 specimens from thirty-six stations. Nearly half the hauls from near South Georgia, the remainder from an area between the South Sandwich Islands and Bouvet Island.

The specimens range in length from 1·5 to 18 mm. They vary greatly in shape and colour, some of them being without the usual ruddy hue. The largest number in a haul (forty-five) occurred at night at the surface (0–5 m.), over soundings of 1000 m. Larvae of 3 mm. and less occurred in one October, three November, two December and two February hauls. Most of the hauls in which *C. antarctica* occurred were made in November, December and January. The species was absent in a number of February and March hauls made in the South Orkneys, South Shetlands and Palmer Archipelago in 1927, although the gear and the depth over which the nets were worked would seem to be quite suitable. The species occurred, however, in an April haul made at the South Shetlands in the same year.

This family is without a glandular dorsal pit and has no suckers. Buccal cones are generally present. There is no lateral gill and rarely a posterior gill. In *Clione* a posterior lobe is present in the foot. It is usually short and broad. There are no chromatophores. The hook sacs contain numerous long hooks. Radula at least 6–1–6. The present species is very closely allied to *C. limacina*, Phipps. Eliot (1907, p. 13) gives a list of differences between the two species. As observed in Terra Nova specimens (Massy, 1920), there is a distinct neck behind the fins, instead of between or above them, as in *C. limacina*. The skin appears to be thicker and larval rings persist to a later age.

DISTRIBUTION. Antarctic seas.

Subfamily *THLIPTODONTINAE*

Genus **Thliptodon**, Boas, 1886

Thliptodon gegenbauri, Boas, 1886.

Thliptodon atlanticus, Massy, 1917.

St. 72. 4·5 m. tow-net, 2000 (–0) m.: 4 specimens.

In this subfamily proboscis, gill and jaw are absent. Teeth of three sorts—formula 3–1–1–1–3—and gullet bladders (vésicules buccales, Schlundblasen) are present.

Genus *Thliptodon*, Ggbr. No cones: hooks present: the lateral lobes of foot sometimes separated from the posterior lobe; pockets exist in the folds of the skin in which the lobes can be withdrawn.

T. gegenbauri is thus characterized by Mme Pruvot-Fol (1926, p. 29): "Lobes du pied réunis; partie céphalique beaucoup plus volumineuse que l'abdomen; crochets très longs, grêles; dent médiane rectangulaire, à tranchant onduleux, ne recouvrant pas entièrement sur les côtés la plaque basale; intermédiaire à cuspide courte mais aiguë; marginales toutes semblables, courbes, aiguës, non aplaties".

The above specimens were taken north-east of the Falkland Islands. They measure 15–19 mm. in length. Two have lost their buccal parts. The radula of the other two is like that of the type. They are more than twice the length of Irish specimens and the fins are wider apart, and the viscera occasionally extend to the end of the body, which is sometimes rounded. I agree with Mme Pruvot-Fol that the small specimens, measuring 3–7 mm., named by me (1917) *T. atlanticus*, are referable to the above. As this author remarks (1926, p. 28) it is always useful to give a figure of a rare species, as so often the radula may take a slightly different direction on the slide which entirely changes the aspect of the various teeth. Thus in the specimens recorded above, the median tooth is much more like that figured by Mme Pruvot-Fol (*loc. cit.*, pl. iii, fig. 74*c*) than Boas' illustration (1886, Tab. 8, fig. 122).

DISTRIBUTION. Messina (Boas, 1886). South-west Ireland (Massy, 1909, and 1917 as *T. atlanticus*). North Atlantic, off Portugal to the Azores, 0–1500 m. (Pruvot-Fol, 1926).

Thliptodon diaphanus, Meisenheimer, 1905.

St. 297. Young-fish trawl, 200–300 (–0) m.: 1 specimen.

This specimen, measuring 7 mm. in length, was taken off the Cape Verde Islands. The radula, especially the median tooth, agrees far more closely with the example figured by Mme Pruvot-Fol (1926, Pl. iii, figs. 79) than with Meisenheimer's illustration (1905, pl. xxvii, fig. 3). Mme Pruvot-Fol (*loc. cit.*, p. 28) thus characterizes this species: "Lobes latéraux et lobe médian du pied séparés par un grand intervalle. Dent médiane à tranchant droit, intermédiaire à cuspide très courte, marginales en lame de faux, aplaties. Organe copulateur pourvu d'un appareil annexe: deux glandes et une ventouse".

DISTRIBUTION. Gulf of Guinea, St Thomas, Sumatra, Seychelles, Gulf of Aden (Meisenheimer, 1905). Ascension I. (Schliemenz, 1906). S.W. Ireland (Massy, 1909 and 1917). Antarctic (Meisenheimer, 1906). Atlantic, between Madeira and the African coast, 0–4000 m. (Pruvot-Fol, 1926).

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PLATE XXXIX

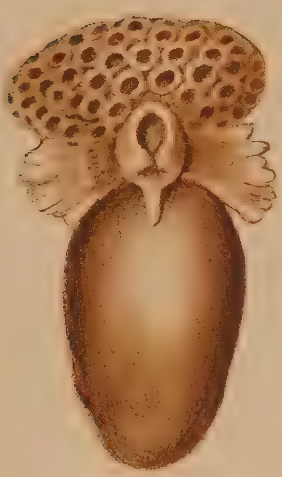
Fig. 1. *Spongiobranchaea intermedia*, Pruvot-Fol, ventral aspect: × 4.

Fig. 1*a*. *S. intermedia*, two suckers enlarged.

Fig. 2. *S. intermedia*, dorsal aspect: × 4.

Fig. 3. *S. intermedia*, contracted specimen, ventral aspect: × 3.

Fig. 4. The same, dorsal aspect: × 3.



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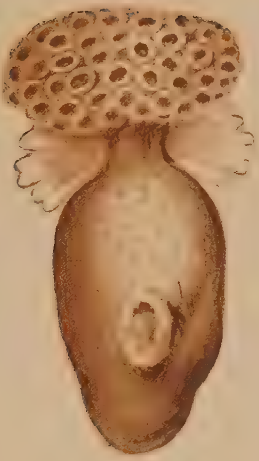

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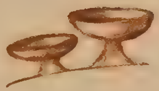

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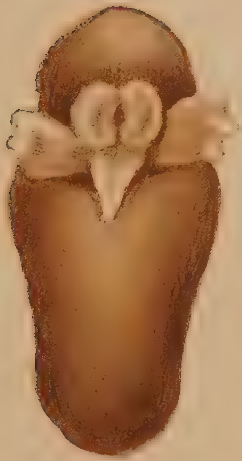

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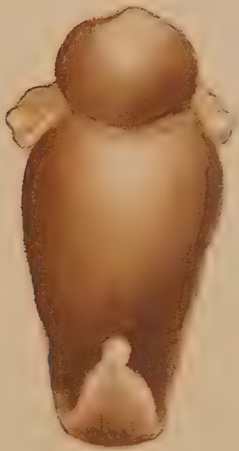

4.

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SPONGIOBRANCHAEA INTERMEDIA.

Discovery Reports, Vol. III, pp. 297–344, Plates XL–XLIV, Charts 1–4, June, 1932]

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NARRATIVE OF HYDROGRAPHIC SURVEY OPERATIONS IN SOUTH GEORGIA AND THE SOUTH SHETLAND ISLANDS, 1926—1930

By

Lieut.-Commander J. M. CHAPLIN, R.N.

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NARRATIVE OF HYDROGRAPHIC SURVEY OPERATIONS IN SOUTH GEORGIA AND THE SOUTH SHETLAND ISLANDS, 1926–1930

By Lieut.-Commander J. M. Chaplin, R.N.

(Plates XL–XLIV; Charts 1–4; text-figs. 1–2)

SURVEY OPERATIONS IN R.R.S. 'DISCOVERY', 1926–7

IN drawing up the plan of operations for the conduct of the investigations, the Discovery Committee recognized that the coasts of the Dependencies of the Falkland Islands were for the most part very poorly charted, and that every effort should be made to improve our knowledge in this direction. But it was realized that there would be difficulties in carrying on this work in conjunction with the scientific investigation of numerous problems connected with whaling. These difficulties were very apparent during the commission of the R.R.S. 'Discovery'; but none the less every opportunity has been taken to extend our knowledge of the coast-line, and comparison of the charts issued with this report with those previously issued by the Admiralty will indicate the measure of success which has been attained.

Our knowledge of the coast-line of South Georgia is still very deficient; and at the time when work began the only harbours which had been properly surveyed were King Edward Cove in West Cumberland Bay (Chart 1) and Royal Bay.

Since 1904, when whaling operations began, the Norwegians have succeeded in obtaining a great deal of local knowledge regarding other harbours in the island, but most of this work is unpublished. The method of navigation which they employ in uncharted waters is to send catchers in advance to find out the dangers—a system of trial and error—and it is a remarkable tribute to their seamanship that so few serious casualties have occurred in the course of these dangerous operations.

In commencing survey operations it was first of all necessary to decide where a start should be made, and since the position of the island itself was not beyond suspicion two harbours were selected at the extreme ends of the island, Undine Harbour in the north-west and Larsen Harbour in the south-east. By this selection it was hoped that the two extremities of the island could be fixed. Both harbours, though small, are extensively used by vessels of the whaling fleet.

A pram and full camp equipment was taken, and at Undine Harbour (Plate XLII, fig. 3) where the survey party was at work from March 22 to March 29, 1926, and from December 9 to December 17, 1927, fairly good camping ground was found; but the weather throughout was bad, the proportion of cloudy to clear days being as 6 to 1. None the less it was found possible to fix positions astronomically and the harbour was sounded and full materials obtained for a plan (Chart 3). At Larsen Harbour (Plate XLIV, fig. 1), which we visited from January 6 to January 13, 1927, the weather was throughout extremely favourable. A whole series of sights was taken and a complete survey made of the rather complicated harbour (Chart 3). The distances were rather great for a small pulling boat, and this resulted in very heavy work on the part of my assistants.

Both Undine and Larsen Harbours are guarded by most difficult approaches, and I was anxious to attempt some sort of a survey. At the time, however, it was not possible to obtain the use of a larger, mechanically driven, boat, and in consequence these approaches still remain to be investigated.[1] On completion of this work it was decided to visit each of the whaling stations in turn, surveying the harbour itself and using any opportunity which might offer to survey the approaches. In this way, during the period from January 17 to January 31, 1927, Leith Harbour (Chart 3) was surveyed and a triangulation of Stromness Bay (Chart 1) carried out, together with soundings in some of the more important areas. I am greatly indebted to Mr Leganger Hansen, manager of the whaling station, for the assistance he gave me throughout my visit to Leith Harbour. He put everything I needed at my disposal with the exception of skilled assistance, which naturally he did not have. This, however, was supplied, so far as was compatible with his other duties, by Mr L. Harrison Matthews, of the scientific staff. After some practice he acquired great facility in the work and on many occasions his help proved indispensable. Thanks to the kindness of Mr Hansen, two excursions were made from Leith Harbour for the purpose of taking sun sights, one to Cape Buller and one to Cape Saunders. On both occasions the sights were successfully taken. A motor boat which was also lent to me at Leith Harbour proved invaluable, but the use of it could only be obtained when it was not engaged on other duties.

A tide-pole was erected in Leith Harbour, and Mr Leganger Hansen very kindly arranged to have systematic hourly readings taken over a period of two complete calendar months. These, together with two months similarly read by the staff of the Marine Biological Station at Grytviken (King Edward Cove), give sufficient data for the determination of the tidal information necessary in South Georgia, where the rise and fall is small and the tidal streams negligible from a navigational point of view. Both these tide-poles were connected by levelling to fixed marks ashore: at Grytviken to a mark cut in the north-west corner of the Biological Station and at Leith Harbour to the top of the inner end of the wharf. Both marks should be recoverable for a long time.

Work in South Georgia ended with additions to the chart of Cumberland Bay: triangulation was effected from a number of points and the positions of Mount Paget and Sugarloaf Peak were fixed (Plate XLII, fig. 1). Owing to the similarity of their appearance on certain bearings these mountains had often been confused, so much so that a wrong leading bearing was included in the sailing directions.

It had been intended, during our passage between South Georgia and the South Orkneys, to search for two vigias (doubtful rocks) which had been reported recently in those regions. The attempt had, however, to be abandoned owing to the adverse weather conditions which prevailed when in the vicinity. The existence of both these

[1] Some revision of the approaches to Undine Harbour was, however, made at a later date by the 'Discovery II', as shown in Chart 3.

rocks was doubtful, for they have never been sighted again and there are reasons for thinking that the reports were based only on black icebergs. Plate XLIII, fig. 2, shows how closely an iceberg with morainic deposit may resemble a rock or small island, and in the rough or misty weather which prevails in these latitudes a mistake is easily made.

In other parts of the Dependencies of the Falkland Islands, in the South Orkneys, South Shetlands and the Palmer Archipelago, the work was of necessity of a much rougher nature (Chart 4). With the exception of a good set of sights taken at Borge Bay in the South Orkneys no opportunity occurred here for astronomical sights from the shore; in consequence we were obliged to rely entirely on the sights obtained at sea, and these, though in many cases quite satisfactory, cannot be compared with shore sights for accuracy. The sights taken at the South Orkneys showed that the positions of these islands differed considerably from those previously assigned to them, as they were found to be 15 miles farther to the eastward than charted. At Borge Bay a sextant triangulation was made, but our visit was too short for the completion of any satisfactory survey work. The sights, however, were well worth a visit and will be useful later. Borge Bay is a passable harbour much used by whalers. Ice drives in occasionally, but it is usually soft and the whalers are able to steam through it to clearer water outside. On the passage to Clarence Island from the South Orkneys an enormous iceberg was found. Along the side that we measured it was 35 miles in length, but in the other direction it was probably still longer, since no end to it could be seen even from the mast-head. Very uneven and shoal soundings obtained just to the north of it indicated that this huge berg was possibly aground.

The position of Clarence Island was provisionally determined from sun sights at sea and simultaneous bearings of the island, and it is thought that the result is reasonably accurate.

Work undertaken by the German exploration vessel 'Meteor' had shown that O'Brien Island is situated farther to the westward than had hitherto appeared, and we ourselves found that the position of Gibbs Island relatively to O'Brien Island was as formerly plotted. It would appear, therefore, that the group which includes both these islands is farther to the westward than had been charted previously; but at this time only one sight of the sun was obtained in confirmation of their position.

The position of Simpson Rock north of King George Island was plotted on our further passage to Deception Island. Deception Island itself had been well charted by Charcot during the First French Antarctic Expedition. I and my assistant[1] obtained good sights during our visit to the island and were able to confirm the position which Charcot had assigned to it. The Austin Rocks were well fixed by simultaneous bearings taken to them and to Deception Island, as also was Sail Rock.

Farther south the positions assigned to nearly all the islands are far from satisfactory, and, although a certain amount of work was done by way of correction, the results cannot be regarded as other than approximate until a further examination has been made.

[1] Throughout the work during this commission, except at Leith Harbour, I was assisted by Midshipman W. P. O'Connor and by Able Seaman Malcolm Smith.

This applies to Hoseason Island, Smith Island, Low Island and Snow Island, all of which we tried to fix in passing by sights taken at sea, and also to the Melchior Archipelago in Schollaert Channel and Port Lockroy in Wiencke Island, at both of which places we were able to land but unfortunately had no day when adequate sights could be obtained. On the passage from Deception Island to Melchior Archipelago and passing Austin Rocks, whose position could now be taken as correct, we obtained a series of six sun sights, three before noon and three after; at the same time, as well as at other times, cross-bearings were taken to all tangents of islands and peaks in sight. At dusk a set of six practically simultaneous star sights was obtained. The sun sights, when worked out and plotted, agreed together very well, as did the star sights, and the same is true of the results of the bearings taken: but although the observations were checked repeatedly by myself and others, the results obtained by the various methods all differed. In view of this discrepancy, for which so far no explanation has been found, it would seem advisable to treat the results of observations taken at sea with extreme caution.

A few soundings were obtained in Port Forster (Deception Island), at Melchior Anchorage, and later in Admiralty Bay (North or Visca Anchorage), which should prove useful.

On our passage from Melchior to Port Lockroy a running sketch survey was carried out by means of the compass and log, the errors of both of which had been so long observed as to be known very accurately.[1]

On one day whilst at Port Lockroy (Plate XLI, fig. 1) the ship went for a short cruise; O'Connor, Smith and I stayed behind, and after carrying out a rough sextant triangulation, sounded out the harbour, using the scale and meridian given by Charcot. A large number of soundings were taken with the small Lucas machine from a pram. It is an excellent harbour; but the surrounding glaciers, by calving, make it uncomfortable and occasionally dangerous. The soundings under these glaciers were therefore reduced to a very few, owing to pieces of ice frequently breaking off.

In addition to the surveying, a large number of soundings were obtained at sea with careful astronomical positions. The Lucas machine, with 6000 fathoms of wire, driven by a Brotherhood steam engine for heaving in, was always employed in making these soundings. Depths up to just under 3000 fathoms were obtained, although it has to be remembered that the 'Discovery' was rather lively and also had to be allowed to lie broadside to the wind when sounding. Thus the rolling often brought an unfair jerk on the wire causing it to carry away, while the ship's drift to leeward sometimes caused the wire to lead well out to windward. On such occasions the tension on the hand-brake springs was often so reduced as to compel us to ease them, and frequently the bottom was not detected owing to the difference of tension on striking being so small. In such cases the depth record was unreliable, and as the wire coiled on the bottom it invariably kinked, and snapped on heaving in.

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[1] The method, although well known, may be described briefly. A departure from a fixed position having been plotted, compass bearings are observed to all prominent objects in sight, such as capes, islets, points and edges of glaciers. Care must be taken to write the objects down carefully and fully, so that no mistake can occur when next they are observed, for all objects change their appearance greatly as the direction alters, and should therefore be kept under observation continually. At the same time as the compass bearings (which, owing to the change of position of the ship, should not include too many points) the time must be taken and the patent log read, while the course should also be carefully recorded. This procedure is continued at intervals to the end of the passage, when the position reached, if not already known, should be fixed by the best means available. In the present survey the latitude of Melchior Observation Spot was observed, and the longitude accepted from previous observers. Port Lockroy was accepted entirely from the position assigned to it by Charcot. The courses steered, after being carefully corrected, were plotted and the bearings laid off, the result being squared in with the end positions. All appeared to give satisfactory results, the current being negligible.

Two sorts of wire were tried. One was the usual 22-gauge single-strand piano wire. This kinks very easily unless kept taut, but if properly cared for is very strong and durable. The other wire, used as an alternative, does not kink nearly so readily. It is of slightly greater diameter and six-stranded; it is in my opinion superior, although not so easy to keep in good condition, and is liable to strand very easily. Sounding wire should be kept well oiled, and we added a self-oiling arrangement, besides various other improvements, to our machine.

Records of all deep-sea soundings made will be found in the Station List, *Discovery Reports*, Vol. 1, pp. 6–74.

SURVEY OPERATIONS, SEASON 1928–9

SURVEY WORK IN M.V. 'ALERT', OCTOBER 15, 1928 TO FEBRUARY 4, 1929, AND MARCH 19 TO APRIL 10, 1929

Preparations

On the 'Discovery's' return to England in October 1927, the work of drawing the fair charts was taken in hand at the Hydrographic Department of the Admiralty, and at this time the possibility of a separate surveying branch was discussed by the Discovery Committee. It was decided finally in June 1928, to organize a separate survey, to be equipped with a 25 ft. motor boat and a 14 ft. pram, and all the necessary instruments, camping equipment and provisions. It was proposed that the expedition should winter in South Georgia in 1929 so that the work should be as little interrupted as possible. In pursuance of this scheme a motor boat and pram were ordered from Messrs J. S. White, of Cowes.

Whilst the motor boat was being built, a crew consisting of an Assistant Surveyor, one motorman and three able seamen was got together, the instruments, camping gear, sounding gear, provisions and wireless telegraphy set were ordered, and by courtesy of the Tönsberg Whaling Company, passages were obtained in the S.S. 'Busen' for the assistant and seamen. They sailed from England on August 18, 1928, to South Georgia, via Tönsberg in Norway.

It was considered desirable that the motor boat should be taken out in the ship in which I sailed, and that in order to look after her the motorman should go in the same vessel. The limited accommodation of a whaling vessel, and the calls made upon it by the numerous personnel requiring passage to the south, made this none too easy. By the courtesy of the Tönsberg Whaling Company, however, and of her Master, Captain Sören Berntsen, the passages needed were secured in the S.S. 'Orwell' and, together with our boats and stores, we sailed from Barry on September 15, 1928. After an uneventful passage we arrived at Husvik on October 13, and were met by my assistant with his men.

The active part of our work now commenced. Our main base was to be the Marine Biological Station at Grytviken. By the courtesy of Mr Hjalmar Andersen, Manager at Husvik, our stores were accordingly transferred there in one of his whale-catchers.

The motor boat, now christened 'Alert' (Plate XL, fig. 1), after some trials, proceeded to Grytviken on October 15, and although light, behaved on the first open-sea trip in a reassuring manner. This trip was undertaken partly as a trial and partly to bring the crew to Grytviken, where they were required to stow the stores, unpack the instruments and fit the wireless telegraphy receiving set, sounding machine and other appliances into place.

When this work was finished we returned to Husvik on October 25, large masses of loose ice in Grytviken Harbour having prevented an earlier passage. While proceeding from place to place in the 'Alert' during the whole of the subsequent operations, covering some 3000 miles, no assistance was ever asked or needed, except on one occasion which will be mentioned in its place.

Husvik and Busen Fjord (Chart 2)

It was decided to survey this area on two different scales, one for Husvik harbour proper and a smaller scale for Busen Fjord.

The work was carried out on normal lines, that is by erecting beacons (a supply of poles had been brought, together with a quantity of calico flags to make them conspicuous) at suitable spots for main stations, and smaller beacons with pieces of calico as sounding marks and to mark the coast-line.

Two theodolites were carried in the 'Alert', leaving one spare at Grytviken; generally they were used simultaneously, one by the assistant, the other by myself.

A difficulty in using theodolites—one which it was impossible to evade—was the attentions of skua gulls, which are very numerous. Unfortunately these birds build their nests on the ground at or near places usually very suitable for main stations. During the whole time the angles were being taken, if a nest were anywhere near, both parent birds would take turns at swooping to within inches of one's head. We killed many with broomsticks (which we carried for sounding marks), so close did they come. As they are large fierce birds, they cannot be disregarded, and we could not spare an extra hand to protect the observer. All we could do was partly to erect the beacon and flag, and use the theodolite from under it. Terns are worse offenders, as they attack in mass formation; but they generally build on rocky screes and cliffs where theodolites are not likely to be set up.

After the plotting had been done coast-lining and sounding could be commenced. Owing to the inexperience of the crew in sounding this was rather awkward at first, and in fact several sounding lines had to be repeated entirely on account of various errors that were made; but as practice gave more confidence the speed became satisfactory.

As occasion offered, true bearings were obtained from *S* to *H* (Fig. 1) and a round of bearings with a 6-in. Dover compass was obtained for variation, from the same spot.

Owing to lack of men the tides could not be watched hourly, but a tide-pole was erected at the pier, and readings obtained when necessary. The rise and fall being only 3 ft. at springs it was only in Husvik Harbour itself that the tide affected soundings sufficiently to repay watching. During the sounding of the harbour an occasional visit would be paid to the tide-pole and a reading taken. The tide-pole was of simple construction, consisting of a wooden batten 7 ft. × 6 in. × $\frac{1}{2}$ in., marked alternate black and white for the feet and long and short lines for the inches (Plate XLI, fig. 2).

Sounding was carried out entirely by Lucas machine on account of the depth. One of the difficulties experienced was the freezing of the lubricating oil in the dial and of water on the reel, while the tallow for arming the lead for bottom samples also used to freeze. When the dial froze up it had to be exchanged (we carried a spare one) and thawed in the engine room; ice could nearly always be broken off the reel. The tallow was kept soft by storing it on the engine exhaust until required.

The Lucas machine was fitted on the transom facing aft, and the leadsman sat on the starboard towing bollard fitted with a pad. In this position the machine was found to be too low, but a stand was made for it and it was then quite convenient for use. The springs had to be watched carefully, as, if the boat was bumping at all in a sea it would make the wire run and check (by taking the weight off the springs), and if the springs were eased back too much there was a fair chance of the wire over-running and giving half an hour's work to clear it; this happened frequently at first. The best weight for the lead was found to be 10 lb. It is to be remembered that the depth sometimes varied from 6 to 60 fathoms in the same line of soundings, and it was thus not possible to adapt the machine to any expected depth.

Observations for position were not considered of primary importance, since the former positions at Leith Harbour and Cape Saunders could be connected up with those of the present operations. This was just as well, for the weather was singularly bad and much time would have been wasted.

The coast-line was walked over only at Husvik, as it was considered that the remainder was not sufficiently important to justify the time necessary. It was found in practice that a good approximation could be sketched in at the ends of the lines of sounding, by joining the small sounding marks which had been fixed already by theodolite angles, and with additional tangents to other objects.

The positions of all the more important peaks were fixed and their heights computed, and the contour lines were then sketched in roughly. The country being so mountainous, to do more would have entailed enormous and perhaps hazardous labour with no commensurate result.

The survey presented no intrinsic difficulties, but was much hampered by bad weather. Out of 30 days (Sundays also counted, as we could not afford to neglect any fine day) only on 12 could we work all day, and on 6 more for a part of the day, a total of 18 days out of 30; the remaining 12 were useless for work owing to wind, snow or fog.

The Harbour was triangulated by theodolite angles from all the main stations (Fig. 1), and angles were also taken to the small beacons and all prominent objects.[1]

The engine ran well at some times, but not at others, and unfortunately the motorman did not seem able to secure any improvement in its action. Consequently there were many unnecessary stoppages, which caused me considerable anxiety, as winds rise with amazing swiftness to hurricane force, and shelter is very scarce. We spent much time out of sight of the whaling station, and had we been blown out to sea, there would have been the greatest difficulty in returning (see Appendix III).

The $3\frac{1}{2}$ in. theodolite was very useful, both because of the speed at which one can use it and of its handiness in transport. It has a levelling bubble and screw of great delicacy on the vertical arc, thus enabling one to keep the instrument accurately horizontal and yet keep the telescope pointing at the object. It can thus be used for solar and stellar observations. For position sights in cold weather it was found infinitely preferable to use a theodolite rather than a sextant and artificial horizon, both because of the time saved in setting up, of working when gloved, and the absence of the fogging, freezing, and other drawbacks of the artificial horizon.

For the other sights also the theodolite was exclusively used. In taking true bearings

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[1] This, briefly, was the procedure:

The Officer in Charge, with two men (motorman and one seaman) erect *D*, then return to the pier, man the 'Alert' and steam to the vicinity of *B* (see Fig. 1). The assistant and two other men would meanwhile erect *N*, then *A*, then *S*, then *B*. The 'Alert' sends the pram (one seaman) ashore and all embark and proceed to *C*. They erect *C* ('Alert' lies off), re-embark and proceed to *G*, land the assistant and one man (with theodolite, etc.), who partly erects *G*. The Officer in Charge meanwhile proceeds to *H* in the 'Alert' and measures a round of angles from that point, twice or more, i.e. he "makes" *H*, the assistant meanwhile making *G*, when ready. In making *G* and *H* the beacon flags had to be partly erected, so that they could be mutually observed. "Making" at a station means setting up the theodolite and taking a round of angles two or more times from that station. In each case the beacon has to be taken down or moved to allow the theodolite to be erected exactly on the site of the beacon. Both at *G* and *H* the erection of beacons is then completed. The Officer in Charge returns to *G*, picks up the assistant, proceeds to *C*, drops the assistant, anchors near *D*, and makes *D*, while the assistant makes *C*. He then picks up the assistant and proceeds to *B*; the assistant makes *B*, the Officer in Charge makes *N*, then *A*. The assistant joins him and the base is measured four times, usually twice each way, with a calibrated steel tape. *N* was in this case a telegraph pole and therefore needed only a flag. The 'Alert' was then boarded and steamed to the pier.

The above work occupied two days and fitted in remarkably well. The assistant being naturally somewhat slower in theodolite work, usually gave the Officer in Charge sufficient time to sail to the next main station and back, or nearly so. The sounding marks were put up while proceeding between main stations.

The triangulation consisted in closing and computing the appropriate sides in the following triangles:

NSA (*NS* 1500 ft. base), *DAS* and *DSC*, this giving side *SC* for the inner harbour scale.

BCS, *BCH*, *GBH*, giving *GB*, which is the long side used for the scale of the outer bay for Busen Fjord. A check is obtained by working also through *NSB*, etc.

The triangles and points were then plotted. It was found that in no case did the error, i.e. the difference of the sum of the internal angles from 180°, in any triangle exceed $1\frac{1}{2}'$. The base was measured four times as usual and the range of difference was only 3 in., although the conditions were not good owing to strong wind and snow; the surface, however, a sheet of fairly firm and flat snow, was excellent.

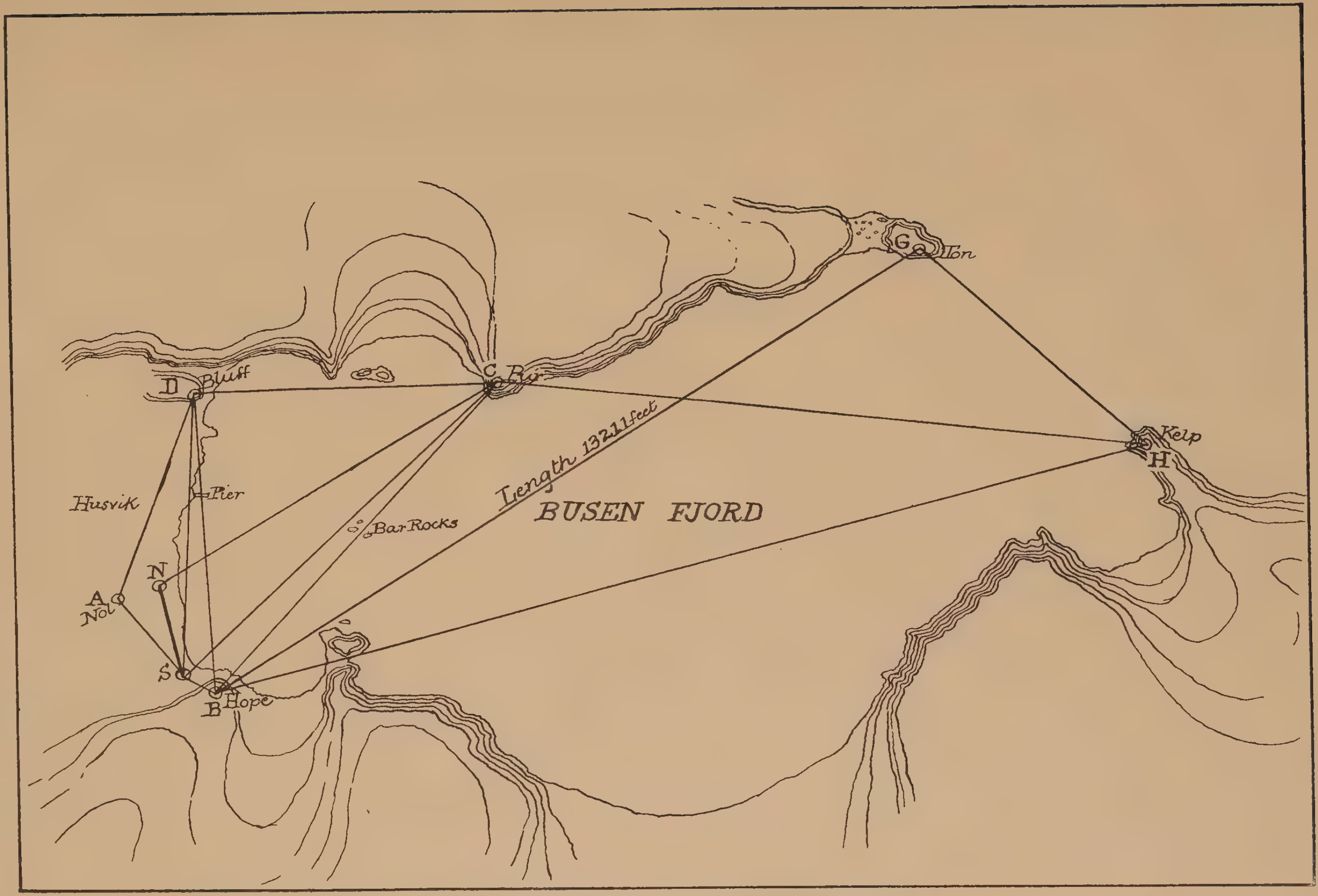

G
Ton
C
Ry
D
Bluff
Kelp
H
Length 13211 feet
BUSEN FJORD
Bar Rocks
Pier
Husvik
N
A
Nol
S
B
Hope

Fig. 1. Scheme of triangulation in Busen Fjord.

the horizontal and vertical arcs were read off simultaneously, and since the readings were made through the same eyepiece, they occupied only a very short time. Usually time to the nearest 0·5 sec. was taken also, and the results worked out independently by both time and arc. The results were afterwards meaned according to their probable relative value, assessed on the experience of the observer and the difficulties caused by the conditions. A check was thus obtained where time for many sets was often lacking owing to clouds, wind or drift snow. Drift snow was a constant nuisance. Even on fine days, if any wind were blowing in the surrounding mountains, a great amount of loose snow would blow off from them, and this, acting as it did exactly like light rain or snow, was quite sufficient in quantity to prevent work with optical instruments. Many fine days were wasted in this way.

During the survey of Husvik and Busen Fjord we lived on board S.S. 'Busen', the station transport vessel, and received very kindly treatment from Captain Hansen, of the 'Busen', and Mr Andersen, the Manager of the whaling station, who never hesitated to give me their assistance and advice.

Stromness and Leith Harbours (Charts 2, 3)

On completion of the survey of Husvik, Stromness, which lies just north of Husvik, was visited. The procedure adopted here was identical with that carried out at Husvik, the only difficulty in its execution being the connection of the two triangulations. A new base was measured, and although the two scales when plotted did not quite agree, the two sets of observations were co-ordinated later, the difference being due to the plotting between Husvik and Stromness. As there was no inner harbour, one scale was used for the whole survey. The survey occupied a much shorter period than that of Husvik, both because there were few shoal patches and because everyone had acquired more experience.

For reasons already given in reference to the Husvik survey, practically no sights were taken. The coast being rather featureless, and of small value, no coast-lining was done except by sketch.

It seemed as if a good position for a measured mile existed here. This would not be suitable for big ships, but quite adequate for whale-catchers. A mile was therefore measured and marked. Captain Sörlle, Manager of the station, kindly put up permanent beacons and leading marks in the indicated positions. Although ships are not built there, yet their best trim for steaming and fuel consumption is often important during hunting, and as economy becomes more urgent, it will increase in importance. The time spent on this rather awkward job I therefore consider to be justified. The method employed was, I believe, accurate to within a very few feet.

The requirements for a measured mile, which will enable ships to arrive at their true speed, are (i) a sufficient run when approaching from either end to allow them to steady on their course and accelerate to their maximum speed, (ii) sufficiently deep water to avoid interference with their speed through drag of the bottom, (iii) a good view of and sufficient distance between each pair of transit beacons marking the extremities of the

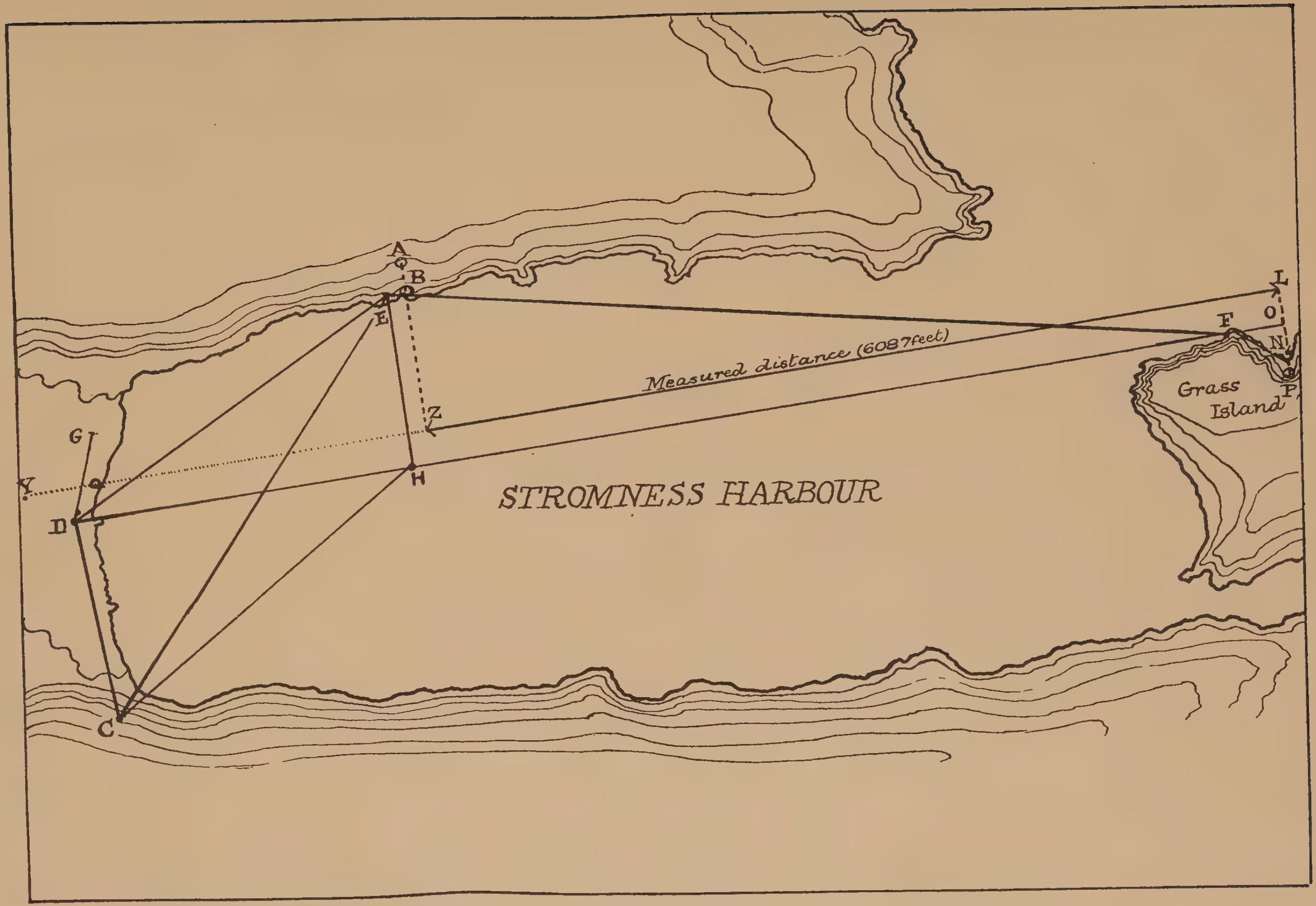

A
B
E
L
O
F
N
P
Grass Island
Measured distance (6087 feet)
Z
G
Y
D
H
STROMNESS HARBOUR
C

Fig. 2. Illustrating the laying down of the measured mile at Stromness.

mile to give a sharp movement when they are in contact, and (iv) a sufficient distance between and clear view of the leading beacons to ensure a steady course. These were all present to a sufficient degree in this instance.

Owing to the configuration of the land, it was found that the usual methods were impossible. The following method was therefore devised, and, although perhaps not rigorously accurate, is sufficiently so to make its employment worth while.

Theodolite angles were taken, with more than usual repetition to ensure accuracy, at *C*, *D*, *E* and *F* (see Fig. 2). The distance *CD* had been calculated direct from the measured base *DG*, through two triangles, and agreed to within a foot or so of 1480 ft. From the triangle *CDE*, the angles of which had been measured, *DE* was calculated, and then *DH* (3414·1 ft.) by dropping a perpendicular from *E* to *FD* at *H*. From *DE* in the triangle already found, *FD* was calculated to be 9435·1 ft.; by subtracting *DH* from *DE* a distance of 6021·0 ft. was obtained for *HF*. So far everything had been straightforward. Unfortunately *HF* could not be the real measured mile, as *F* was on land and also was backed at about 5 ft. from the sea by a perpendicular precipice giving no room for a rear beacon, but it was the only spot from which all the other main stations necessary could be seen.

A point *N* farther along the coast to the eastward of *F* was suitable, as it had a flat rocky ledge behind it for 70 ft., which was sufficient for the distance between front and rear beacons. A careful angle was taken to a mark placed here and the distance was measured, this being the hypotenuse of the small triangle *FNO*. The distance *FO* was the distance to be added to *HF* for the actual total between the two pairs of beacons.

Then the 'Alert' was run out from *N* for a couple of hundred feet, and a point mentally marked on the beach at Stromness (a red hut, quite conspicuous) near *D* for the real line, this being as nearly as possible parallel to *FD*. On adding 99·3 ft. to the distance *HF*, this being *FO* the resultant of the angle, etc. to the real marks at *N*, it was found that the mile (or the beacons) from the selected positions, chosen as they were by rough measurement, was 33 ft. too long. Then, as the outer beacon at *N* could not be shifted, the inner beacon at *E* was moved a carefully measured distance of 33 ft. towards *N*. The setting up of marks for the rear beacons in each case was fairly simple, as a sextant was all that was required, with a man moving a small mark until it coincided with the correct position with the sextant at 90°. For the rear leading mark we simply carried a baulk of timber up country as far as we could, and with the hut as the foresight, set it up so that the approximate place off *N* was in line. It was then planted and painted white (*Y*).

Although this method cannot be called rigorously accurate, I think it will be found sufficiently near, and in the circumstances was the only one that appeared practicable.

FD	9435·1 ft.
DH	−3414·1 ft.
∴ *HF*	6021·0 ft.
FO	99·3 ft.
HO	6120·3 ft.

33·3 ft. in excess of the nautical mile, which is 6087 ft. (approximately) in the latitude of South Georgia.

$HO = ZL + 33{\cdot}3$ ft. being parallel and between the same perpendiculars, therefore $ZL = 6087$ ft. very nearly.

A considerable swell frequently comes into Stromness Harbour, notwithstanding the protection afforded by Grass Island, and the Transport Ship 'Peder Bogen' often rolls very heavily alongside the jetty. During this time the sounding of Stromness Bay was resumed where it had been left in 1927. No new dangers to navigation were discovered, except some more kelp in the entrance, but a wreck was erased from the charts of Stromness Bay, there being 80 fathoms of water where it appeared on the existing charts.

On completion of Stromness Harbour, Leith Harbour was visited and the sounding of Stromness Bay completed from there, as well as some additional work in Leith Harbour, with soundings and theodolite angles to new stations in Stromness Bay. Captain Bjönnes Hansen, of the S.S. 'Peder Bogen', and Captain Sörlle, the Manager of the Stromness whaling station were as kind as possible in every way, as were also Mr Leganger Hansen of Leith Harbour, an old and ever-helpful friend, and Captain Ridland of the S.S. 'Coronda'.

One ever-recurring trouble was the difficulty of keeping the beacons from being blown down. This was due both to the violent winds and to no firm hold being obtainable in the iron-hard frostbound snow or earth during the spring and autumn. The earth, moreover, is very seldom more than a foot deep with rock beneath. Many hours were spent in re-erecting beacons.

Having completed this part of our work, we returned to Grytviken for a few days to spend Christmas.

Maiviken (Chart 2)

It had been decided that the harbours near Grytviken and those to the south-east should be examined during the first season. In accordance with this plan, Maiviken, a harbour much used by the whale-catchers for shelter, was first dealt with. The Maiviken survey proved to be a fairly straightforward piece of work, although, as there is very little flat land, it was difficult to find a base. This difficulty was met with very frequently. A short base, but one sufficiently long for such a small harbour, was eventually measured.

Whilst here a large beacon was placed on a knoll at the entrance, to enable a connection to be made with other work in Cumberland Bay as opportunity should occur; but this beacon, being much exposed to wind from West Cumberland Bay, blew down repeatedly. Here also our anxieties about mooring commenced. Fortunately we had no swell, otherwise there would have been many anxious moments.

Jason Harbour (Chart 2)

To complete the necessary harbours in Cumberland Bay it was decided to continue with Jason Harbour. The choice would in fact have been forced on us, as in attempting to go outside we were driven back by wind.

At Jason Harbour, although there was an apparently good little inner harbour protected by a reef across half the entrance, the swell from a south-east gale was so heavy as to carry away our stern mooring. Strangely enough there was no wind whatever inside, since the high mountains did not allow it to blow home. The swell became in fact so big that we had to shift our camp well above high-water mark. Here everything went very well except the theodolite observations at the north-east main station at Tor point, where the ground was so springy with tussac that only with the $3\frac{1}{2}$ inch theodolite could any good be done. This, of course, is because there is no need to walk round it to take readings. The tussac is always bad for theodolite work, owing to the springiness of the roots and because one has to climb over tufts as much as 2 ft. high, and in so doing can easily displace the theodolite. This applies only in the late summer: at other seasons everything is frozen hard and excellently firm, and the tussac is not nearly so luxuriant.

A good base was measured here on the shore of an unexpected lagoon. The lagoon is unfortunately no good for ships, as it is merely connected with the sea by a very narrow cut which can only admit a small boat: even the 'Alert' could not negotiate it safely.

The sounding of this harbour was not concluded at this stage, because I intended leaving it for the winter, to see if it were possible to work then, and also because it was better to carry on with the more important and distant work.

Godthul (Chart 2)

On the next fine day, January 21, after calling at Grytviken to complete with stores (a matter of a few hours), we proceeded to Godthul. We had already made a voyage to this place for a preliminary inspection. The harbour forms a good but deep anchorage and was frequented by a Factory Ship, the 'Thor I', Captain Horndtved, during the season. After examining it, it was decided that a small cove, which we named Pleasant Cove (Chart 2), appeared to be a suitable camping ground (Plate XLI, fig. 2). We made our camp there and found that for a small vessel or a camp it is one of the most suitable spots on the island, being well sheltered both from wind and swell from all directions, and very often clear when outside there is thick fog or rain. The sun also shines in from sunrise, but unfortunately it sets behind the high peak to the north-west at a very early hour. These advantages were not realized at the time, and I constantly felt a quite unnecessary anxiety for the safety of the 'Alert'. Almost from the beginning we placed one man on board during the night, in case of emergency, and occasionally two, or even my assistant as well; but it was felt that the discomfort was so great as not to justify having more than one unless the weather was very threatening.

Up to this time, although there had been a considerable amount of precipitation, it was all or nearly all snow, though sometimes, it is true, snow in a very wet state, which hardly lay at all during the day. The tents did not become very wet, as their flapping, either by the wind or by deliberate shaking, shook off most of the snow before it had time to melt during the day, and during the night it was seldom warm enough for snow to melt. Consequently we escaped during this time what are probably the greatest discomforts of a camp, wet tents and damp sleeping bags.

We used three tents, two for sleeping and one for cooking, as it was found that the moisture from the steam of cooking condensed inside and dripped, thereby annulling the benefit of the warmth from the cookers. The waterproof sleeping-bag covers also were not satisfactory, as there is no ventilation and the moisture condensed inside: they are capable of improvement in this direction.

It was during this survey that we experienced our first open-sea work, for we combined the survey of Godthul with a coastal survey from Cape George to Barff Point (Plate XLIII, fig. 4), a stretch of approximately 6 miles. This work entailed the exercise of ingenuity in the measurement of a base and in scheming an adequate triangulation. There was no flat ground whatsoever, and it was decided to stretch a spare piece of sounding wire between two main stations and measure it by means of steel tape afterwards. The wire was wound on a reel and set up aft in the 'Alert'. One end was then sent ashore attached to a Salter's balance and secured to the first base; the 'Alert' was then steamed to the second base and passed close alongside it keeping the wire taut, which was easy as the wire floated on the top of the kelp, and had small floats at intervals, and therefore remained straight. When the second base was exactly abeam, the wire was marked, the balance read and the wire rewound. The ends of the base were on rocky points near water level. On return to camp the wire was measured in sections several times by means of a steel tape, keeping the same strain on it. A base of 2500 ft. was measured with a probable error of less than 1/500. It is doubtful if a portable range-finder, even had we possessed one, could have given better results. In practice the strain was taken off when measuring wire after the first measurement, as it was realized that any contraction would tend to neutralize errors due to the wire sagging.

The triangulation difficulties were also of a practical nature and were due to the precipitous coast and the constant swell rolling against it. The overcoming of the difficulties was due largely to the courageous manner in which Mr O'Connor and one or other of the seamen, Purvis, Briggs or Alsford, tackled the landings, carrying beacon poles and flags, spun-yarn stays, stakes, theodolite and legs. All were necessarily heavily dressed to be able to stand taking angles for hours in low temperature and exposed situations, and were wearing sea-boots for landing. I have no hesitation in saying that a slip on those slimy rocks—and they were all slimy with sea-weed—would have meant immersion in icy cold water and almost certain death. Such landings were made on numerous occasions, then and later. The pram was always used, and backed with her square stern close to the rock; then, on top of the swell, here seldom less than 10 ft. high, the first person would jump, then take the gear piece by piece from the second, until finally the second could jump. Naturally the boat had to be handled very carefully meanwhile. Our usual boatman was Briggs, who became very good at the work. This was not the end of the adventure, since now would come the climb, heavily laden with gear, up a rock sometimes almost vertical and from 30 to 100 ft. in height. Occasionally the rocks were so steep that the gear had to be hauled up by means of spun-yarn. The embarkation at the end of the business would be, if anything, even more hazardous, entailing as it did climbing down (which is worse than climbing up), and jumping from a slippery surface into a small bobbing boat. I need scarcely say that I was more afraid for their safety than they were for their own.

During these operations, the 'Alert' could not be left unattended, and therefore either lay off waiting, or proceeded to some more sheltered spot, if any useful work could be found there. Generally she waited, because of the treacherous weather, which never gave much warning of a change for the worse.

Even with the stations made as above, the triangulation had to depend to a certain extent on calculated angles, to wit, those at O'Connor Peak. O'Connor Peak cannot easily be climbed, but having a very well-defined sharp point it became an important position, more especially since we depended upon it in connecting this triangulation with that of Cumberland Bay.

There were a great many days when landing was definitely impossible, and this delayed the work considerably. During this time also the general weather conditions were particularly vile, snow and fog alternating for days on end, with only the briefest fine intervals.

Every opportunity was taken of working outside, leaving Godthul and Pleasant Cove for windy days; but even so these were both completed some time before the coastal strip. The importance of this part of the coast lies in the fact that it is near Grytviken, the principal harbour of the island, yet is very foul, and that there is a good navigable channel for small vessels inside the rocks, which is frequently used by whale-catchers.

The 'Norvegia' came in during our stay, and went alongside Messrs Bryde and Dahl's Floating Factory, the 'Thor I', which had arrived some days previously. The 'Norvegia' had completed a voyage made in search of new whaling grounds and for scientific research, and was going to lay up at Grytviken for the winter.

During the sounding between Barff Point and Cape George some data were obtained for deducing the current. The method used, on those occasions when a flat calm ensured that there would be no wind effect, was to plot the 'Alert's' position by sextant angles at intervals to determine her drift. The current seemed to vary between $\frac{1}{2}$ and $1\frac{1}{4}$ knots in a west-north-west direction. These results, of course, are not conclusive, having been obtained over a comparatively short period; but they should give an indication of the general conditions to be expected.

In the time at our disposal the topography during this survey was not considered to merit more than a sketch, and with the exception of some of the more outstanding features, no more was attempted. Heights were obtained where possible by theodolite elevated angles, and when any summits were climbed the aneroid was used and found to agree well with the theodolite results up to about 500 ft. or a little more. The coast-line was practically inaccessible except in a few places, and was therefore also sketched in.

One of our main stations at Godthul, at a height of 520 ft., became very useful, as on going up one day when a very heavy swell prevailed outside, we managed with our theodolite to obtain angles to all the breakers in sight. These angles were very useful afterwards, in combination with other angles, to fix these breakers. Angles of depression were also obtained to all these. Although not realized at the time, one of these breakers turned out to be the Fridtjof Nansen Bank and another a breaker very seldom seen off Cape George. Unfortunately the latter was not observed again and is therefore still not definitely fixed: the depth over it must be considerable, probably 4 or 5 fathoms.

The end of the season was approaching as we completed the survey, and having regard to the shortening days and bad weather, it was not considered desirable to commence other work before the winter. The snow was now beginning to lie thickly. Moreover, we had to take over the Marine Biological Station from those then in charge of it. The return to Grytviken, therefore, was decided on, and was eventually carried out on April 10, 1929. We completed some work on the way.

It was on one of our periodical returns to Grytviken from Godthul for stores that we had our worst passage. Although the outside portion of the passage is only 6 miles, an hour's run, between our departure from Pleasant Cove and our arrival at 'Alert' Rock, when about half way, the wind from a flat calm became north-west, right in our teeth, and of force 6. Since the glass was falling and the breeze still freshening, I decided that we should have to maintain full speed at all costs to get into comparative shelter as soon as possible. It was not a very pleasant experience, as we took some green seas right over and had to start pumping, but the boat behaved very well. By this time, in the considerable sea running, we could not have turned back without great danger.

I mention this passage to show how quickly the weather may become impossible for a small boat round these coasts. Of course, also, the danger of the engine developing some trouble had always to be borne in mind. We had the sail to fall back upon, but the 'Alert' was naturally not very weatherly, and the large sea-anchor we had made, though useful to keep her head to the wind in case of temporary stoppage, would not have kept her from going ashore. The 45-lb. anchor would not give great security, as until actually on the coast the depth of water is so great that no anchor could be expected to get a grip in time.

SURVEY WORK IN R.R.S. 'WILLIAM SCORESBY', FEBRUARY 5 TO MARCH 18, 1929

On one of our periodical returns to Grytviken for fuel, we were informed that the 'William Scoresby' was leaving very shortly for a month's cruise in the South Shetlands. This being an excellent opportunity of extending our knowledge there, I immediately arranged to take passage in her with my assistant and one hand. We proceeded on February 5 round the north-west of South Georgia and outside Willis Islands. Passing a short distance off Willis Islands, O'Connor got some observations and bearings, confirming the fact that they are charted too far west and are actually some miles nearer Bird Island (Chart 3). A report to this effect was made.

The 'William Scoresby' was of course occupied on her ordinary work and could not depart from her programme. This, however, included visits to various localities I wished to revisit, including Elephant Island, Admiralty Bay, the north coast of Trinity Peninsula, Deception Island, and all those islands to the south-west which have been mentioned as being very doubtfully charted. Without going into the voyage in detail, it may be said at once that it was rather disappointing. From the time we left South Georgia until we finally left the South Shetlands, we were in almost continual fog. There were three notable exceptions. Just as we approached Elephant Island it cleared splendidly, and remained so all day, an opportunity which was instantly seized, and reliable positions were established by solar observations for Elephant Island and Gibbs Island. The second exception was off Admiralty Bay, where some satisfactory stellar observations were obtained, showing definitely that a south-westward counter-current flows down the southern shores of Bransfield Strait.

The third and perhaps most important exception occurred on arrival at Deception, where the day turned out perfect (we were there only twenty-four hours). Instantly it was decided to climb Mount Pond, the highest point of the island, with O'Connor and Alsford, and if possible take a round of angles with a theodolite and a true bearing by sun. The ascent was safely accomplished with only one incident, when O'Connor, owing to the sun blinding him, failed to observe the depression in the snow caused by a narrow crevasse, put his foot through, and nearly followed. He was prevented from doing so by the theodolite legs which he was carrying. On arrival at the top, 1870 ft. by aneroid, a glorious view was obtained, and the weather being absolutely clear a range of vision of over 100 miles was possible. It is believed that Mt Français in Anvers Island, about 120 miles distant, was seen. The theodolite was set up and a very good round of angles obtained, and then a couple of sets of observations for true bearing. This, although by itself insufficient to determine the positions of the various objects taken, when combined with other bearings will enable us to plot them. As the position of Deception is now in no doubt, those of the objects sighted will thus be determined. No trouble was experienced in taking these observations, except that the metal-shod legs of the theodolite, warmed by the sun, were inclined to sink in the ice, notwithstanding the fact that they had been provided with flat wooden shoes.

The fog came down again next day, and although we saw the islands (Low, Snow, Smith, etc.) occasionally and also managed to take some sun sights, nothing of sufficient accuracy was obtained.

We returned to South Georgia after calling at Stanley, Falkland Islands, for a few days. At Stanley we again checked the variation and got some theodolite angles from Sappers Hill to fix the position of the wireless telegraphy masts and some new topographical features. We finally arrived back at Grytviken on March 18 after a voyage which might have yielded exceptionally important results had circumstances been somewhat more favourable.

We resumed the survey of Godthul where it was left off. The 'Alert' had been slipped before we sailed and during our absence the two who remained behind had given her a thorough overhaul and painting.

WINTER IN GRYTVIKEN, 1929

On reaching Grytviken we immediately commenced taking over the Marine Biological Station and making some preparations for the winter. These consisted mainly in seeing that the buildings were secure and as airtight as possible, in providing adequate moorings for the 'Alert', and in seeing to our fuel stocks. With a view to carrying out some work during the winter, the 'Alert' was left afloat and moored inside the Magistrate's Pier with stout ropes. These are decidedly necessary, as the south-west wind blows on to the pier with great violence.

The programme for the winter was easily arranged, as the charts of Husvik, Stromness, Godthul, Pleasant Cove, Maiviken and Jason Harbour had to be drawn and their sailing directions written up.

Work was arranged for forenoon and evening, leaving the afternoon for skiing or other open-air sport. This allowed the personnel to take as much advantage as possible of the somewhat short daylight hours for recreation in the open.

Whilst my assistant and myself were drawing the fair sheets, the remainder were employed in refitting the boats, and they had in addition to do the housework. Stock was taken of the stores, and indents for replacements were made out. Any spare time left over was devoted to cleaning and painting portions of the house.

Bearing in mind that it was not intended to camp during the winter, the opportunities for field work were limited. There would have been many more but for the freezing over of King Edward Cove on fine calm days. The ice never became very heavy, but was sufficiently so to prevent a boat like the 'Alert', of fairly light construction and not much power, from steaming. One or two attempts to proceed were made, but although the copper sheathing protected the hull from the sharp splinters, it was torn off owing to the unfortunate fact that it overlapped the wrong way, that is, fore and aft, instead of vertically. It was replaced without difficulty and remained useful for very thin and loose ice, though it would have been better had it been taken farther aft past the swell of the bow.

In July our only winter visitor arrived, the S.S. 'Falkland' from the Falkland Islands. At the Master's suggestion, I piloted her from Grytviken to Husvik and then to Leith, thus getting an opportunity of having a practical test for my charts. It was at this time that an extraordinary spell of warm weather occurred; the temperature rose to 50° F. and rain fell almost continuously for three days, nearly all the snow disappearing near sea-level.

Just before this, on June 27, a severe earthquake was felt, finishing at 12 hours 51 min. 30 sec. G.M.T. The shock lasted continuously for about three minutes. No damage was done, as all the houses are of exceptionally strong and elastic construction, mainly of wood on a concrete foundation. It was apparently the first earthquake experienced since 1911. Another shock was reported on July 1 during the night, but this was not observed by us.

On August 3 and 4 the Winter Sports were held and all the party entered for the ski race. Briggs, Able Seaman, won a cup, and all the remainder received medals.

On August 18, at about 8.30 a.m., an avalanche came down the scree slopes of Coronda Peak at Leith Harbour and completed the destruction of the old part of the whaling station. Owing to the time it occurred, most of the men had not come back to work from the mess and only six were caught. Three of these were killed. Two men were buried several feet deep for nearly two hours, but when recovered were apparently none the worse for their experience.

On August 31 we dry-docked the 'Alert' for three days to give her bottom a couple of coats of paint, and to examine her propeller and shaft.

The charts were completed on September 25 and despatched via Monte Video on October 1 in charge of Captain Williams of the transport 'Southern King', who kindly arranged to send them on from that port in the personal charge of the Captain of another ship which was homeward bound. They comprised the following:

Plans: Husvik.
Pleasant Cove.
Maiviken.
Jason Harbour.
Charts: Stromness Harbour and Busen Fjord.
Barff Point to Cape George, including Godthul.
Tracings: Stromness Bay
Cumberland Bay } showing additional soundings and details.
King Edward Cove
Wilson Harbour, drawn from details supplied by Lt.-Cdr. Mercer, of the 'William Scoresby'.

SURVEY OPERATIONS, SEASON 1929–30

SURVEY WORK IN M.V. 'ALERT', SEPTEMBER 27, 1929 TO FEBRUARY 16, 1930, AND FEBRUARY 20 TO APRIL 13, 1930

It now became necessary to prepare for the forthcoming season, and the 'Alert' was accordingly filled up with fuel, stores and all necessary equipment.

The whaling stations all opened about the third week in September, but actual whaling did not commence until the end of the month, as the flensing plans had to be cleared of snow and all plant prepared for work.

The zoological staff were to occupy the Marine Biological Station during the coming season, and it was decided to await their arrival, as the fires had to be kept alight and the water prevented from freezing. On September 15, however, I was informed that the party would not arrive until the beginning of October, which was rather late. We therefore turned the house over to the Magistrate's care and prepared to leave immediately.

The programme was to proceed north and survey the remaining harbour used as a whaling station, Prince Olaf Harbour, and as many of the more generally used harbours as time would permit. With this intention we proceeded to Stromness Bay on the first fine day. Being informed that the 'Orwell' had arrived at Husvik, bringing our season's stores, we called there and sorted and checked them. We then visited Stromness and Leith, and the weather being unsuitable for work, stayed a few days. Here we met the zoological staff, who arrived in the Factory Ship 'Antarctic'.

Fortuna Bay (Chart 3)

We proceeded on October 15, the weather although calm being foggy, and we were lucky in finding Fortuna Bay, which was our goal, at the first attempt. We arrived there in an unexpectedly short time, and this caused us to suspect an error in its charted position. That we heard the steam whistle from Stromness or Leith, although separated from us by high hills, also showed the proximity of these stations. The error in position was confirmed later, as our sights then put the bay some distance farther to the south-east than charted.

Fortuna Bay is a large open bay with some rocks, Fortuna Rocks, at the entrance, which serve to protect it somewhat from the north. It is sheltered by high precipitous mountains on all sides but the south. There is, however, a gap half-way down the western side, a branch of the Fortuna Glacier, which is a conspicuous mark from seaward. At this gap, where a glacier comes towards the bay, there is a small bay and anchorage. Although owing to the gap there is more wind here, there is little swell, as compared with the considerable swell usual in Fortuna Bay, and elsewhere the water is too deep for anchoring. We called this Anchorage Bay.

A camp was made a little to the south of Anchorage Bay and moorings laid out for the 'Alert'.

At each new place we had difficulty in choosing the best camping site. We naturally learnt by experience, but at first no one could say where the best place would, in fact, turn out to be. The main consideration was shelter for the 'Alert', fairly near the beach in shallow, but not too shallow, water. The kind of anchorage we found best was in about 4 to 5 fathoms, within 50 yards of the beach, with good holding ground of mud or fine sand and mud. It was essential that the camp should be in sight of the boat, and of course above high-water mark. Then an adequate water supply, not too far away, was needed, and finally, a piece of fairly level dry ground, clear of elephant seals, and fairly clear of penguins.

We always tried to avoid the immediate vicinity of elephant seals. The reason was that they could become very great nuisances, especially at night and when the weather was going to be bad—which was very frequently. The air was then always filled with the bellowing and the bleating of the mothers and calves. Further unpleasantness was occasioned by their apparent liking for the side of the tent to lie against, as it appeared to fit the contours of their bodies. The tents being of the Antarctic type, with no ropes but a deep valance which was weighted with snow (or anything else, like sand or shingle), the result was a furrow with the tent wall on one side. The weight of a seal is, however, rather too much for a tent, and they had to be discouraged, although they are normally very peaceful sleepers.

The requirements for a camp were not easy to fulfil. At Maiviken the boat was not too well protected and we should have had to shift in the event of east wind. At Pleasant Cove there was no dry ground except on large pebbles just on the high-water line, and we should have had to move the camp with a spring tide or a more than usually heavy swell (Plate XLI, fig. 2). At Jason Harbour we actually did have to move the camp owing to the swell, and the boat did not lie very comfortably.

Here, at Fortuna Bay, the appearance of the beach suggested a quite heavy swell at times. So far as the camp was concerned this did not matter, as the snow being still fairly thick on the ground, and smooth and soft, we could camp anywhere in fairly dry conditions. With the 'Alert' the case was different, for to moor in water which was deep enough not to break would entail going out too far, and the water then deepened very steeply, giving rise to the danger of the anchors slipping off. We got over this difficulty by making a long 30 fathom 3½-in. hemp spring fast to a rock on shore. We had done this before, but whereas up to now we had moored head and stern, here we allowed the 'Alert' to swing: this seemed to be the wisest course, as the wind here changed from north to south and back often and quickly, owing to the hills behind.

Having camped, we commenced triangulation as usual. We were again favoured by a flat snow surface, which permitted the measuring of a 2100 ft. base in full view of all the four main stations we made. The triangulation was completed in three days, and some inshore sounding carried out by the pram. The coast-line was also walked over, round the south-west end.

At this point I was disturbed to find that our petrol consumption had become excessive, and that we were now making only 1½ miles to the gallon, instead of 2½ miles. Owing to the inexperience of Alsford, who was acting as motorman, the cause could not be detected. It was laid down that a margin above the estimated requirements of at least 10 gallons should always be kept for passages in the open sea. This reserve is not quite as great as it seems, as owing to the shape of the tank, 2 or 3 gallons are always left in its bottom. Having to reach Prince Olaf Harbour, our next stop, a distance of at least 20 miles, with possible delays, I could not afford to use any more petrol for sounding. Accordingly we decided to leave completion of the sounding until our return after finishing the surveys in the north-west.

We made ready for departure, therefore, and after having to wait two days for favourable weather, left on October 25. The day turned out, however, worse than was expected. When passing the end of Fortuna Glacier and across Antarctic Bay, with a westerly wind of force 7, we had to tack across to prevent being swamped. It was impossible to turn back, so we steamed to Cape Constance, where of course we were sheltered. On venturing into Possession Bay, however, it was seen that the crossing would be impossible, the wind being force 8 to 9 and the sea a white sheet of foam. We therefore returned to the small harbour made by the two horns of Cape Constance. Owing to the gusts which buffeted us all night we called this harbour Windy Cove.

Next morning we completed the voyage to Prince Olaf Harbour with a fresh easterly breeze, to which we set all sail and bowled along at 8 or 9 knots. It was the most unpleasant passage we had had so far. These fjords all have very bad reputations for sudden and furious winds, but I believe that Possession Bay is the worst.

We were made very welcome by the Manager, Captain Abrahamsen, who did all he could to help us and make us comfortable, both then and during all our time in the north-western part of the island. Thanks to his kindness the defect in the engine was soon set right.

Prince Olaf Harbour (Chart 3)

Having laid our moorings for the 'Alert' in the best anchorage we had found so far, in 5 fathoms with a mud bottom and no swell, we proceeded with the usual triangulation. There was here little or no flat ground (a very usual complaint), and the base had to be measured across the reservoir. This reservoir, being covered with ice, made a good though rather short base. Unfortunately, however, it was in a hollow surrounded by rather steep hills, and it was a difficult problem to find a suitable point to which to extend it. By taking very great care with the angles a good extension was made. The ice on the lake, owing to the rise and fall of water, was rather rotten and we therefore again used wire and measured it with steel tape afterwards. Owing to the flat surface the wire could be kept quite straight without much tension, and the result was very satisfactory.

The remainder of the triangulation presented no difficulty and embraced the approaches as far as Cape Crewe and Black Head. This work involved making ten main stations, including Sheep Point Light and Cape Crewe Light. At Black Head O'Connor had an unusually bad landing and a difficult climb to the top. He here saw a sheep which had escaped from the station and had become quite wild. It appeared to be thriving, though it was supposed to have been there two or three years. Elsewhere the difficulties of landing were slight.

The Inner Harbour had been reported foul the previous year, and the depth was small. A great many more soundings were therefore taken than would have been the case in deeper water, as the work of sounding had to be done very carefully. A small area alongside the hulk had to be left, since it was occupied by the transport S.S. 'Southern King': this, however, was completed afterwards on one of our later visits.

The weather here during the first part of our stay was an agreeable change from what we usually had, and the work progressed very favourably, giving rise to great hopes for the season. Unfortunately this weather did not continue. Still, the work done compared well in amount with that carried out during the same period in the previous year.

The job of anchoring, turning, and mooring ships which go alongside the hulk always presented a ticklish problem in this harbour, owing to the very restricted space. The 400-ft. 'Southern King' was particularly difficult to handle. It was suggested that leading and clearing beacons would simplify the business and make it less precarious. Accordingly we selected sites for five beacons, making three pairs of leading marks (including one chimney) for anchoring and turning the ship clear of danger. Substantial beacons were erected, fixed, and charted before we left.

Bay of Isles (Chart 3)

On completion of Prince Olaf Harbour it was decided to proceed to the more or less detailed survey of the Bay of Isles, which though itself of no very immediate importance navigationally, gives access to two moderately good anchorages, namely Rosita or Allardyce Harbour and Elephant Beach Anchorage. The remaining bays are open to much swell as well as being exposed to very strong wind.

A trip was accordingly made to the Bay of Isles for carrying out a preliminary examination, but a thick fog descended and spoilt the operation. On the first suitable day, November 28, we proceeded with the work. On this particular day the weather was gloriously exhilarating, with clear blue sky and delightful air—as an occasional day can be in South Georgia. Leaving fairly early in the morning, we soon covered the short distance to Cape Wilson and then made a complete coastal reconnaissance, following the shore closely right round to Cape Buller and keeping a careful look-out for a likely camping ground. We concluded that there were only three possible places, each with several disadvantages. We deliberated for some time, and finally decided on a spot on the south side of Camp Bay as being the least unpleasant; it had some shelter from most winds and a jutting promontory gave protection, as I thought, from swell. The beach was stony and the anchorage for the 'Alert' was in the middle of kelp, but about the right depth, 4 to 5 fathoms, with a bottom of stones and sand. The tents were erected on the stones on the beach, mitigated by as much moss and tussac as we could find.

The first four days proved quite fine, and notwithstanding the distances involved, a great deal of the triangulation was carried out. The bay measures 9½ by 8 miles and contains nine islands, nearly all of similar height but in size varying from Albatross Island, approximately 1 mile square, to little Dot Island, a mere large rock.

Then, on a rainy but calm day, it was decided to replenish fuel at Prince Olaf Harbour. This was always our main preoccupation, as we could carry a shorter supply of that than of anything else. We obtained our fuel and accomplished the round journey in less than five hours, bringing back another 50 gallons of petrol. The next day was again fine and further work was carried out.

The weather during the following night, however, became worse: a breeze from the east began to bring in a swell, which rapidly became fairly heavy. Until this time our practice had been to haul the pram on the beach at night. The beach here, however, was so stony that even the pram began to suffer, notwithstanding her extra bilge planks; accordingly she was anchored a short distance off with a 30-lb. anchor. At about 4 a.m., December 2, we were awakened by the noise of her being thrown on the beach, whereupon O'Connor and the men turned out and hauled her up, undamaged, but unfortunately with one oar missing. This turned out to be a real misfortune, as with wind and swell still increasing and the latter beginning to break with some violence, it became necessary to think of the safety of the 'Alert'.

The wind from the east was blowing right into Camp Bay, but the bluff kept it from touching our small nook. The only danger therefore was the swell, which curled round the end of the rocky point in which the bluff ended, and when as far in as the 'Alert', became a ground swell of respectable proportions. Unfortunately, with the surf then breaking, we could not hope to launch the pram with only one oar. As, however, the swell did not break nearly as far out as the 'Alert' and she was riding easily, no immediate danger was apprehended. We tried to shout a message to the 'Alert', but the noise of water was too strong for it to be heard.

All would have been well had the 'Alert' been swinging to her moorings, but unfortunately in order to prevent her swinging outside the protecting point, she had been made fast by a fairly taut line from her stern to a rock on shore. At low water, about 2 p.m., a swell larger than usual came in. It broke out the weather anchor (she was moored with three) and carried her in on its crest, casting her on the stony beach just before the other anchors took the strain (Plate XL, fig. 2).

At the time, the motorman and one seaman were on board. They were, however, completely helpless in the suddenness of the emergency. Immediate steps were taken to land the instruments and more important books, and to bowse everything taut to prevent bumping; at the first opportunity all gear was landed, and the 'Alert' hauled up above high-water mark. Unfortunately during these operations all hands became wet and most of the instruments and books suffered to some extent. It was snowing hard all the time.

For the men not much could be done, as the supply of dry clothing was very scanty, but Captain Abrahamsen, at Prince Olaf Harbour, had made us a Christmas present of rum, which was most welcome. The temperature varied from 29 to 35° F., and we had to contrive to dry the things by an extempore petrol-tin stove and a little damp driftwood. Primus stoves are not well adapted for drying clothes.

For the books and instruments little could be done until the weather improved, although as much as possible was attempted with the theodolite and chronometer. Unfortunately the means as well as the skill was lacking, and the chronometer could not be saved, neither could the small theodolite, being too complicated for us to take apart. The other instruments were eventually made serviceable, although the cases of most of them came to pieces, and one or two small instruments were lost altogether.

Although she was hauled up as far as possible, the big surf still bumped the 'Alert' very considerably and the total damage, most of which was done when driving over the rocks below low-water mark, was considerable. The rudder and rudder-post were both carried away, a large hole was made in the bilge on both sides, and the keel was "chewed up". The propeller did not touch, I think, and the shaft was only very slightly bent through straining of the hull. The only damage to the engine was the spoiling of the magneto by water. The most important loss was that of a small note-book containing much work, some of which had not as yet been taken to a further stage. When the sea went down, a long search was made along all the surrounding beaches for any gear washed up, but nothing of value was recovered.

It now became our task to patch the 'Alert' as well as possible and get her back into the water. The repair was executed at low water with waterproof sheets and sleeping-bag covers, the whole secured with strips of copper from the sheathing and a large supply of copper tacks provided for such an emergency. It was carried out extraordinarily well, as results showed. This work was done under terrible conditions, lying on one's back with icy cold water swirling and splashing near, snow falling, and a temperature seldom above freezing-point; but throughout it was done with the utmost cheerfulness. My assistant and his men showed the greatest resource and endurance, working whenever there was light enough, and frequently getting wet.

When all was finished, our attention was taken up with the task of turning the 'Alert' with bow to seaward and getting her as nearly afloat as possible. This was accomplished at considerable pains by means of two or three small planks (the only ones on the beach) used as skids and levers, and our cables rigged as Spanish windlasses—the latter mainly at the motorman's suggestion. Finally, on December 10, she was pointing seaward with all movable parts taken out, propeller off, tanks out—in fact a mere shell. The anchors, of course, were still laid out (one on each bow), and the 40-fathom cable right ahead: all bar taut, and with a chain on either quarter keeping her upright.

Meanwhile we had not neglected to make signals. On every clear night we had kept a sharp look-out for passing whale-catchers, and whenever a light was seen a large petrol fire was lighted on a prominent bluff. We sighted a catcher one night and four of them two nights later. We were 10 miles from the entrance and no one saw us, but by good chance one of our beacon poles on Skua Island, near the entrance, fell half-way, and the flapping of the flag in this unnatural position attracted the attention of Gunner Antonsen of the 'Southern Shore'. He reported the matter, saying he had seen us waving a flag from one of the islands. He did not come himself, as the spare whale-catcher from Prince Olaf Harbour could make the passage in an hour, and he had whales in tow.

This news was doubted in Prince Olaf Harbour, as they did not think we were on an island; but finally it was decided that as we had been away fourteen days there would be no harm in sending us our mail and looking us up, and a whale-catcher was sent in search of us. It was naturally thought that we were probably marooned on the island from which the signal came, and this occasioned some delay in finding us, but ultimately we were discovered.

We attracted her attention by burning large fires, but being daylight they were not readily seen. On reaching us she informed us that she could not wait, and since the tide would not be up for three or four hours she promised to return next morning, if the weather permitted our being moved.

Unfortunately, during the night it began to blow again from the east and it became necessary to do something lest all our work should be undone. We were forced, therefore, after having waited until 1 a.m. in the hopes that the weather would not become very bad, to load her with large stones to the limit of her capacity and safety to prevent her bumping; but even so, such was the violence of the surf which was breaking right over her, that she did bump somewhat. Apart, however, from shifting her back a little, and tearing off some of the patches, this appears to have done no harm. As usual it snowed heavily all the time. The whale-catcher did not arrive that day, for apart from its being thick, and therefore dangerous for her to attempt to come near us in this unknown bay, it would have been useless to try to tow us round in existing weather conditions. The weather did not moderate for two more days, but then, much to my relief, and doubtless that of the remainder of the party, we saw the whale-catcher heave in sight. This was on December 12.

The tide again was not high enough and also was now past springs. We employed ourselves in getting the tow rope round the 'Alert' and removing the stones, and with four stout planks, borrowed from the whale-catcher and secured under the bilge, it was thought she could be safely towed off at high water, even if not quite afloat. Eight empty drums also were lashed inside to the engine to help keep her afloat. It was not considered necessary to take all hands in the 'Alert', but three of us, O'Connor, Alsford and myself, went in her to bail and pump. We towed the pram astern.

At about 2 p.m. I gave the signal, and with only a moderate amount of scraping noise she slid into the water and was hauled alongside the whale-catcher. We waited some time, and found that we could easily keep the water under with the pump. We then proceeded at reduced speed. We had no rudder, but she kept dead straight.

After a few minutes the pump got choked and we had to bail with buckets and tins; we were glad to find that by this means we could just manage to cope with the influx. Meanwhile the whale-catcher, seeing that everything was going well, increased speed, until by the time we reached Cape Wilson she was going full speed: we were still doing well. There was a fairly heavy swell but little wind, and the 'Alert' began to tug and pluck at the towrope. I was glad, therefore, that we had placed the rope right round everything. After an uneventful journey of about two hours we arrived in Prince Olaf, and since the 'Alert' would not float without pumping, she was hauled up on the slip at once.

Repairs to the 'Alert' were put in hand with the staff at the whaling station, and on December 19 we took the opportunity to return to Grytviken in a whale-catcher to spend Christmas and attend to our correspondence.

After a pleasant five days, we returned to Prince Olaf Harbour. Not being certain how long it would be before we could proceed with our work, I provided myself with drawing material and finding that time would suffice, drew the fair chart of Prince Olaf Harbour. Shortly afterwards this chart was sent home in care of the Captain of the 'Southern King'.

On January 11 hull repairs were completed, and the 'Alert', having previously had some coats of paint, was launched. The remainder of the work, lockers and adjustments of the engines, was then proceeded with, and with exhaustive trials and re-adjustments, occupied us until January 21.

On January 23 we returned to the Bay of Isles, but decided to camp in a cove in

Rosita Bay, which although exposed to wind was sheltered from heavy swell. There was not much choice. During the repairs I had had the fuel tanks re-arranged and the lockers widened; this enabled at least four of us to sleep on board, and this was now always done, the only person to sleep ashore being the cook of the day. It was not the height of luxury, but safer for the 'Alert'.

The work was resumed. A number of the beacons had blown down, and progress was extremely slow. The weather was bad on the whole, and several days and nights were spent standing by with the engine running, for fear the anchors should drag.

The depth of water over the whole bay, with the exception of some patches, is so great that a great deal of time was occupied in sounding. This was reduced to a minimum by spacing the soundings, and this could be done quite safely, as the kelp was always a dependable guide to shoals. On rough days, when a big swell would come rolling in, breakers were easy to detect and were always looked for from some high point on shore.

At last, on February 9, the work was completed and we returned to Prince Olaf Harbour, where as usual we were most kindly received by the Manager.

After our return to Prince Olaf Station, opportunity was taken for O'Connor to ascend the Snow Pap of 2100 ft., situated behind Prince Olaf Harbour, from which all the main stations, both at the Bay of Isles and Prince Olaf Harbour, could be seen on a clear day. This was done with a view to connecting the Bay of Isles with Prince Olaf Harbour, angles to the peak having already been taken in both. The climb, although not very difficult, was arduous when carrying the theodolite, and the wind at the top was fresh. A round of angles was successfully taken and a cairn was built to mark the spot. In addition the gap in the soundings alongside the hulk, now vacant, was filled in, as well as one or two lacunae in the soundings of Cook Bay and some details previously left over.

It was decided to remain near Prince Olaf Harbour until a decision had been reached as to the hire of a whale-catcher for certain purposes beyond the capacity of the 'Alert'. During this time some details in the Bay of Isles were completed, and two additional pairs of beacons were finished and fixed, to facilitate anchorage in South Bay, Prince Olaf Harbour.

On February 19, the day after our return from a short cruise in the whale-catcher 'Southern Pride' (see p. 332), the Sports Meeting for the Governor's Cup and other prizes took place at Stromness, and all the party proceeded there excepting myself. The sports went on until the following Sunday, January 21, but were spoilt by the terrible weather, notwithstanding the keenness displayed by the rival stations. I proceeded there on Sunday, saw the finals and returned the same evening in a south-west gale.

We had been unable to fix adequately a breaking rock off the Bay of Isles, and I decided to do so on the next opportunity, besides taking a few more soundings in the south-eastern part of the bay. The rock was fixed after some search and only 2½ fathoms found on it. It was called Rescue Rock, since had it not been there the 'Southern Shore' would probably have passed farther out and not seen our supposed signal.

Blue Whale Harbour (Chart 3)

This was now the only useful harbour unsurveyed in the neighbourhood, and we proceeded to it on February 26. It has not hitherto even been indicated on the charts; in fact I had not heard about it except quite casually until we arrived at Prince Olaf Station, from which, being across Possession Bay, it is not at a great distance.

In general appearance, size and shape Blue Whale Harbour much resembles Maiviken and a harbour called Elsehul, afterwards surveyed. It is quite a good little harbour, but the entrance and centre are much fouled by kelp. There is little wind or swell.

Nothing of an unusual nature happened here, but owing to lack of sights, for the usual reason—weather, we were compelled to erect a beacon in sight of Prince Olaf Harbour Observation Spot. This part of the survey was completed on March 2.

It had been decided that any further open-sea survey work undertaken should be carried out in the 'William Scoresby'. We proceeded accordingly to Grytviken, taking advantage of the docking there of the whale-catcher 'Southern Flower', which was expected to take about four days, thus giving plenty of margin for possible delay in the 'William Scoresby's' arrival. She arrived in Grytviken, in fact, a few hours after us, on March 3.

The details of our work in the 'William Scoresby' were soon satisfactorily settled and approved by the Committee and Dr Kemp. The 'Southern Flower' did not leave until March 8, but our time was fully occupied in clearing up our stores and charts.

On our return to Prince Olaf we completed the orientation of Blue Whale Harbour. This necessitated the re-erection of a beacon there, and making the station, as no sights had been, or could be, obtained. The true meridian was calculated by means of reciprocal theodolite angles from the above main station and the station at the Observation Spot at Prince Olaf, which had, of course, to be visible from each other. This appears to be a very satisfactory method if care is exercised.

It was found that the engine in the 'Alert' did not develop full power during this trip without knocking badly, and nearly two days were spent trying to find the cause of the trouble. This was never quite decided, but probably the main reasons were an overload through slight overtightening and the actual weight we were compelled to carry. The knocking was never quite eliminated, but it was so much reduced that it was not considered sufficient to warrant further delay.

Here it may be remarked that although the 'Alert' averaged a speed of nearly 7½ knots during full-speed trials, she could only make about 6 when fully loaded with fuel, provisions, instruments and camp equipment, as well as towing the pram with extra drums of fuel. Any reduction of speed was therefore rather serious in a long passage such as the next one to Elsehul.

Elsehul (Chart 2)

The distance from Prince Olaf to Elsehul is a little under 35 nautical miles, and for the greater part of the distance there is no refuge in the event of unfavourable weather during the passage, Right Whale Bay not being suitable. The Manager of Prince Olaf Station very kindly offered to put the 'Southern Pride' at our disposal to tow or escort us, and in preference to wasting time I accepted, although I was disappointed at being compelled to accept assistance at the last stage of our work; it was the only assistance we should have needed throughout. This help, however, was found to be unnecessary. On March 12, just after the engine had been re-assembled and tested successfully, the day broke calm, though dull and with a steady and low barometer. The prospect was thus fair, as the dangerous winds are northerly and are accompanied by a falling barometer, while a rising glass means a southerly, and therefore off-shore wind. We made all speed to leave, and getting under weigh proceeded, watching the barometer carefully. At Cape Buller, our last chance of sheltering, after two hours' run, it was decided to proceed, although the glass showed a tendency to fall and the sky to the north-west was darkening. The breeze began to freshen from the north-west, and sail was set. This, as it turned out, made a considerable difference to our eventual success. The wind was fortunately backing slightly, and remained fair. The going was excellent until The Brothers, north of Elsehul, were reached, when, course having to be altered to the southward, the following seas threatened to come over the stern; the wooden canopy, however, which had been built over the cockpit and for 3 ft. forward saved nearly all of it. The pram also made many attempts to climb on board—as usual in a following sea—and had to be kept off with a boathook. The wind by now was rather too fresh to reduce sail. Nothing of any moment happened and we made the shelter of Elsehul after almost exactly five hours' passage, helped greatly, of course, on the last 20 miles by the sail. The petrol consumption was 15 gallons.

Elsehul, a charming little harbour (Plate XLII, fig. 2), is spoilt by the swell, which almost continuously prevails except on the western beach (where landing is always possible), and by the excessive precipitation. This was my third visit to the neighbourhood, as I had spent two periods at Undine a few hundred yards away across Survey Isthmus; and during twenty-six days altogether spent here there were only three really fine days. The harbour is much used by whale-catchers, both for shelter and for mooring whales; it is, moreover, far less exposed to wind than Undine. Once during our present stay no less than seven catchers were anchored in the inner and outer harbours quite comfortably.

During the day of our arrival the wind rose to gale force, with heavy gusts, and no work was possible. The camping ground on the western shore was found to be quite excellent, and the landing good on a sandy beach. These harbours, however, can often spring unpleasant surprises when everything appears safe, as we know to our cost. Behind the camp we subsequently found in a large brick oven, covered with tussac, three large trying-out pots, similar to those found at other places in the island. These pots were brought by early sealers and had been undisturbed for probably almost a century.

The base, a short one, was measured on this western beach. The survey here presented no special features, except that it was proposed to connect it with Undine. It was fortunate that this could be done; no opportunity offered of obtaining any sights whatever for position or bearing during our stay, and these were therefore taken (calculated) from Undine. The outer harbour and approaches were difficult to deal with, and although my assistant landed on Pillar Rock he could not take a theodolite and had to use a sextant. It had been intended to make some sort of survey of Bird Sound (Strait of Laroche) and the approaches, but the weather was so persistently unfavourable that all these projects had to be abandoned in view of the lateness of the season and the delays which were sure to occur on our return journey to Grytviken, observing that we had to finish the work in the 'William Scoresby' before we could complete our packing. The eastern point of Bird Island and also Cape Alexandra were fixed, although not rigorously. The inner and outer harbours were sounded out, showing that the anchorage is made up of two basins with sandy and muddy bottom and 4–6 and 9–11 fathoms depth respectively. In the outer harbour there are some foul patches guarded by kelp, but the approaches to Elsehul on a middle course are quite clean. The Observation Spot in Undine Harbour and the original triangle were found again, and the former, marked by a large rock with a cross cut in the top, can be regarded as permanent.

It had been decided that we should leave as soon after the 20th as possible, in order to allow sufficient time for probable delays on our way, and for completing several pieces of work. The first opportunity occurred on March 24, on the heels of a westerly gale which had begun to blow itself out. The coast from Elsehul to Right Whale Bay, where it was proposed to attempt a short survey, contains no glaciers and is very high: no heavy wind was therefore to be expected from the south-west, that is, off shore. On leaving, although the swell was very heavy, other conditions were perfect and Right Whale Bay was reached after a very good passage. Some of the fuel taken there earlier in the season had to be left in a cleft at Elsehul, owing to lack of storage space on board.

Right Whale Bay (Chart 2)

Owing to the entire lack of adequate shelter, it was imperative that the time spent in Right Whale Bay should be as short as possible. It was accordingly intended to conduct a running survey only; and the procedure followed, which is somewhat different in detail from the usual method, may be of interest. It was as follows:

From the middle of the entrance a conspicuous object near the middle of the beach at the head of the bay was brought in line with the edge of the glacier behind it; then a previously prepared wooden mark was dropped and angles were taken all round to all conspicuous objects; after steaming out a little to gather way, we proceeded at full speed past the mark, carefully taking the time by stopwatch when abeam. After running a certain time, corresponding to approximately 3000 ft., another mark was dropped, the course being carefully kept in transit with the previously mentioned shore marks and noted: here the engines were stopped. A return to the second mark was then made, when another round of angles was taken to the same points as at the first mark. A third mark on the line of course was now dropped, distances between succeeding marks being made approximately the same, and angles taken from the third mark to the chosen objects. On this occasion it was found that there was insufficient room to run farther than the second, so the third set was taken outside the first, still of course on the transit, checking the first run on the way. The zero line in determining angles for the outer and middle marks was that through beach mark and edge of glacier, and this line being unsuitable for use at the inner mark, which was too close to the beach for the purpose, the zero line was there taken as the line through the two outer points. On plotting, the lines drawn to the objects chosen for observation were found to converge satisfactorily.

The sounding then proceeded on the usual lines, the coast-line being sketched in from the end of each line of soundings. As the bottom was found to be even at the inner end (the anchorage), many soundings were not necessary; but the limits of the various kelp patches at the entrace were roughly fixed. The error of the compass was checked later, and the distance was checked by some runs on the measured mile at Stromness. This is a sufficiently accurate survey for a little used harbour, although a greater degree of precision could be attained by the careful use of a rangefinder.

On leaving Right Whale Bay, the swell being still very heavy, a good look out was kept for breakers or other indication of shoal water which had been reported in this region. None was seen, although anything with less than about 6 fathoms over it would, I think, have certainly been detected. Differences in the steepness of the swell indicated, however, that the bottom was very uneven. The weather remained fine until near Cape Crewe and we arrived in Prince Olaf Harbour soon after dark without further incident, except to observe the antics of a 30 ft. Sei whale, which played round us when near the Barlas Bank, Bay of Isles.

It was now desirable to proceed with all despatch on our way to Grytviken, as it was intended to do a quick survey of Possession Bay and Antarctic Bay, if at all possible. We had Blue Whale Bay to visit also, and the survey of Fortuna Bay to complete. As delays were to be expected, an early start was indicated; but before beginning this work it was necessary to return our accumulated stores to Grytviken. This was commenced next day, which incidentally turned out bad enough to compel the whale-catchers to return to harbour. The stores were placed on a whale-catcher going to Grytviken on March 27, the weather being still very bad. On the return of my assistant and his men on the same day, we were all ready to proceed. O'Connor said that this was the worst trip he had ever made in a whale-catcher.

Possession Bay (Chart 3)

On the afternoon of March 29 the weather improved, and we proceeded to the survey of Possession Bay. The method was the same as that used at Right Whale Bay; here, however, the scale was provided by the triangulation of Prince Olaf Harbour, as was also the true bearing through the main station at Black Head. The final result was in consequence considerably improved. Not many soundings were taken, as the depths were found to be great, and the bay clear of dangers except at the inner end. The bay, moreover, is not important as a harbour; it is very windy and contains only one possible but doubtful anchorage. Captain Cook's landing is in this bay, but is not, I believe, known. Here again the result of the survey was satisfactory. The scale by the run was compared with the scale by the triangulation and the difference turned out to be about 5 per cent.

The next day, March 30, we proceeded on the next stage of the voyage to Fortuna Bay. Antarctic Bay is of little use for navigation. It had been intended to complete a running survey of the bay on the way, but as the weather showed signs of becoming worse, it was deemed inadvisable to risk being detained there. This would have been particularly undesirable, as the bay was entirely unknown to me. It was on leaving Prince Olaf Harbour that we, for the first time, hoisted our colours and paying-off pennant, these and the ensign staff having been manufactured by the men. We called in at Blue Whale Bay to fill in a small lacuna in our soundings and then proceeded to Fortuna Bay, arriving there in time to avoid the weather, which was blowing up from the north-west.

Fortuna Bay (Chart 3)

The sounding of Fortuna Bay was immediately proceeded with and a good deal of it finished before nightfall, notwithstanding the strong wind which had by now risen on the east side of the bay. Next day the work was resumed, in the hope of being able to leave for Stromness Bay on the following day. The sounding was completed; but departure was delayed, as we could see without going out that there was a big sea running, with a strong wind.

By the evening of April 1, however, the wind had veered sufficiently to give us a lee down to Cape Saunders, and we proceeded with a heavy swell, in which we were mistaken for a small growler by a whale-catcher which passed us on her way to Leith. Although the wind was blowing with considerable strength out of Stromness Bay, we were able to reach Leith Harbour at the cost of a good soaking; but this, as we were not going to camp, did not worry us.

Stromness Bay (Chart 2)

Having now completed the major portion of our passage, it was decided to spend a few days in Stromness Bay, running the measured mile, fixing a few further details (such as a new light at Leith), and finally visiting the Managers of the whaling stations, who had helped so much to make the commission successful. The decision to stay would have been forced on us in any case, as from the next day a spell of foul weather set in, culminating on April 6, 7 and 8 in a terrific gale, commencing as usual in the north-west. In this gale the stout moorings of the S.S. 'Coronda' were carried away, forcing her to fill her ballast tanks and rest on the bottom. The wind also bent a chimney ashore. Next day the gale, having veered to the west, blew down a hut and wireless telegraphy mast, and blew off a roof at Stromness. Still veering, it blew with great violence at Husvik, and prevented the factory ship entering or having any communication with the shore. This was believed to have been the strongest gale of the season: certainly it seemed to last longer than usual. As was usually the case, the gale was hardly felt at the Meteorological Station at Grytviken.

During this time we took occasion to revisit all three harbours and our friends at each, according as the wind permitted. Finally, on April 9, in beautiful weather, we rehoisted our colours and pennant and left Stromness Bay for good.

The final stage of our voyage was uneventful, with little wind but colossal following swell. We arrived at Grytviken about lunch time, having stopped outside for awhile to clean ship. At my request, a photograph of the 'Alert' was taken by Mr Saunders of the staff of the Marine Biological Station (Plate XL, fig. 1).

During every passage from harbour to harbour, whenever it was humanly possible, a rough sketch survey of the coast-line was always made. Of almost all the coast from Larsen Point to Farewell Point (Bird Island) two such sketches at least were made, one while travelling in one direction, and one on the return passage. The terminal points we connected in each case with the harbours between which they are situated. These connecting pieces of coast seem to contain nothing of any navigational value which cannot be shown in the sketches. The latter are considered sufficient for practical purposes, especially as they were done in the 'Alert' at a very short distance off shore—very much nearer, in fact, than any larger craft could approach with safety. In the passage up the south-west coast in the 'William Scoresby' (which was made later) the coast as charted from Undine South Harbour to Cape Demidov was found to be grossly in error, and an adjustment was attempted. This, although at best only a very rough approximation, is considered to be much better than the existing charts. As this coast is practically unvisited, however, this is of the less consequence.

As arranged I went out in the 'William Scoresby', although only for a week, starting on Monday morning, April 14, and leaving my assistant behind to superintend slipping the boats, and listing and packing the gear. The slipping of the 'Alert' was a delicate piece of work; it entailed hauling her up on the Marine Biological Station slip, moving her 10 ft. to one side, and finally hauling her up on a bed between two boatsheds. All this was accomplished by O'Connor with no outside assistance, and with no power of any sort except a small hand winch. The boat weighs $2\frac{1}{2}$ tons or more. Not a yarn was broken. This piece of work reflects great credit on him and his three men Alsford, Briggs and Purvis. The engine also had to be greased and everything made snug for the winter, and this also was excellently carried out by the same hands.

SURVEY WORK IN WHALE-CATCHER 'SOUTHERN PRIDE', FEBRUARY 17–19, 1930

This work in the 'Southern Pride' occupied two days.

On Monday, February 17, the weather looked promising, and having put all necessary instruments and the sounding machine on board the whale-catcher on the previous day, we made a start from Prince Olaf Harbour at 6 a.m. In conversation with the gunners of some of the whale-catchers who had been coming here for many years, information had been obtained as to several rocks and shoals, of which previously we had not even heard. These, with their approximate positions, had been transmitted to the Committee for the information of the Hydrographic Office, but they had not hitherto been properly fixed. It was our intention, therefore, to commence by fixing as many of them as possible.

North and West Coast (Chart 1)

This day, although we reached Elsehul, we had thick fog and could do nothing: but we prepared to leave whenever it should clear. Next morning, although wet at an early hour, cleared up by 7 a.m. and we proceeded. First a line of soundings was run through Bird Sound (Strait of Laroche), then, taking a departure from Pearson Point, the west end of Bird Island, we completed a running sketch survey of the Willis Islands and the rocks to the westward of them. These were found to be 3 miles east of their charted position, as we had reported in 1929. A course was then shaped to pass over the positions of two breakers reported north of Willis Islands, but although a sharp look out was kept from the mast-head and there was sufficient swell to break in at least 3 or 4 fathoms, nothing was seen of either. A sounding was taken at each position, yielding in each case about 50 fathoms.

Thence, running south through Stewart Strait, we fixed the position of a breaker west of Bird Island. Here also some soundings were taken and solar observations were obtained two or three times.

Our next work was fixing and sketching Annenkov Island and a rock reported to the southward. A departure from Cape Paryadin was taken and a distance run which tallied with the charted position of Annenkov. Unfortunately, as was to be expected, clouds, mist, occasional rain and a freshening westerly wind now commenced to hamper us, so that we could not see any of the mainland, which would have helped us to fix the island firmly. It is considered, however, that the approximation is fairly close.

The accuracy of position assigned to the rock to the southward, which we called Theodor Rock, after the gunner, Theodor Hansen, who told me of it, depends upon the position of Annenkov.

Returning northward after our visit to Theodor Rock, I wished if possible to pass east of Annenkov, and accordingly we steered for its south-east point. On getting fairly close we found that there appeared to be an uninterrupted reef with some larger rocks and islets extending nearly as far as Cape Darnley, and we were compelled reluctantly to abandon the idea. A passage is reported between Cape Darnley and the easternmost rocks.

Pickersgill Island was considered too far for examination, as the weather was becoming rapidly worse, and it was now about 5 p.m. Course was shaped, therefore, for Holmestrand, which I wished to inspect. Neither I nor the crew of the whale-catcher had ever been there and its charting is, to say the least, imaginative. We spent some time in the falling dusk looking for it. Having passed a particular spot, I happened to glance round and saw a large roller break not 150 yards astern. We decided to return to Prince Olaf Harbour and were obliged to heave to during the middle of the night when the squalls were specially thick. We arrived in Prince Olaf Harbour at about 6 a.m. It was, I think, a most successful trip, helped largely by the ready co-operation of the Master of the whale-catcher, Captain Mathisen.

It had been noticed everywhere about South Georgia that most points, headlands, etc., presented a similar appearance, that is, an almost flat-topped rocky ledge at nearly water-level, and at the landward side of this a rocky somewhat flat-topped hummock or hummocks, with vertical sides and covered by tussac. It occurred to me that all these hummocks were almost the same height, that is, 80 or 90 ft. The weathering of the stones is of course caused by the action of sea water and assisted by freezing and thawing. The height of the hummocks is affected by the amount of tussac, and this might account for the difference of 10 ft. or so that was observed. It is suggested that these hummocks were at some period at water-level and were raised fairly suddenly, thus accounting for the steep sides and nearly equal heights. I regret to say that I know nothing of geology, so make this suggestion with great diffidence. The photograph of Cape George (Plate XLIII, fig. 3) illustrates the feature to which I refer.

SURVEY WORK IN R.R.S. 'WILLIAM SCORESBY', APRIL 14-19, 1930

We proceeded south from King Edward Cove on Tuesday morning, April 15, going inside all the rocks, through the channel we had surveyed the year before, and so testing practically the work already carried out. We then entered Godthul and thereafter tried to find the Nansen Bank. Owing to the serious inaccuracy of the chart, and the fact that the sea was comparatively calm and thus did not break on the bank, we did not succeed. We abandoned the attempt for the time being, as the conditions were so unfavourable, and went on to the Clerke Rocks instead. There we were favoured by luck, for just as we came near enough to see them at dusk that evening, the sky cleared and enabled me to observe several stars. At the same time some bearings of the main rock with run between were taken: this enabled us to fix the rocks effectively. We lay off for the night and carried out a running survey next morning. This turned out satisfactorily. The charted position of the rocks was appreciably incorrect, and their coast-line entirely different.

On completion, we shaped course for Larsen Harbour (Plate XLIV, fig. 1), where the night was spent. Next morning a sketch of the coast was made from Larsen Harbour to Green Islands, and a run up the coast was carried out for the proposed checking of the positions of Pickersgill and Annenkov Islands. This was done by log distance from Green Islands to Wilson Harbour and compass course and bearing, and showed them to be charted very nearly correctly.

Wilson Harbour was reached after dark, and the night was spent there. Next day, after a quick sketch to verify the previously made sketch survey, course was shaped to pass through Stewart Strait, between Willis and Bird Islands. Two new patches of kelp were fixed to the north of Bird Island (Milward Patches), and Elsehul was entered. Course was then shaped to examine the area west of Welcome Rocks, but nothing was observed, possibly owing to the small swell.

After one or two soundings and a tour round the Bay of Isles, it was decided that no useful purpose would be served by staying out the night, and we therefore returned to Grytviken.

Next day we resumed the search for the Nansen Bank. In this attempt we had the kind assistance of Captain Esbensen, Manager of the Cia. Argentina de Pesca's Station at Grytviken. The bank was found and fixed, including the 18-ft. head, which was now breaking. As already mentioned a theodolite angle from an Observation Station near Godthul had been obtained during the previous survey, and this assisted in fixing the bank.

A sketch survey of New Fortuna Bay (a good, though windy harbour) was made, and many soundings taken, and the existence of Penguin Bank, except as a small fringe to the coast, was disproved. We then returned to Grytviken.

CONCLUSION

At Grytviken we met for the first time the R.R.S. 'Discovery II' and made the acquaintance of her officers, who received us with great hospitality; and we met again with pleasure old friends of the R.R.S. 'Discovery'.

Homeward passages were kindly offered us in S.S. 'Harpon' of the Cia. Argentina de Pesca and on May 10 we left Grytviken. We had a good passage to Norway, via Monte Video, and thence home. On the way we managed to obtain a great deal of information from Captain Johannessen, of the sealing vessel 'Diaz', concerning the south-west coast and two new harbours, Diaz or Sealer Cove, and Rocky Bay, which he had rediscovered lately. A small very rough sketch of each and some other details were made with his assistance. The entrance to Diaz Cove had been fixed during the voyage in the 'William Scoresby'. A great deal of information, some of which was afterwards verified, was obtainable at all times from Managers, Captains and Gunners of whale-catchers, to whom we are very deeply indebted for their very cordial co-operation. In some cases it proved possible to pay a lasting tribute to our informants by naming coastal features after them: and, when it occurred, this opportunity was gladly taken.

On arrival in London, the drawing of the fair sheets was at once proceeded with, together with sailing directions and triangulation schemes for all the work. These were completed on October 17, 1930.

The charts comprised the following surveys for the season:

Plans: Prince Olaf Harbour (drawn before).
Blue Whale Bay.
Elsehul.
Charts: Fortuna Bay, including Anchorage Bay.
Bay of Isles, including Rosita Bay.
Cook Bay, and approaches to Prince Olaf Harbour.
Right Whale Bay.
Possession Bay.
Sheets: One, containing sketches of eight stretches of coast line.
Two running surveys of various groups of islands and sketches of harbours.
Tracing of Cape Buller to Cape Constance.
Thirteen triangulation sheets.

Figures of mileage and of time taken during survey operations are approximately as follows:

Number of miles steamed in M.V. 'Alert'	3000 miles
Number of miles of coastline charted	357 miles
Number of square miles covered by survey	101 square miles
Number of main stations made	112
Number of soundings (hand machine and hand lines)	13600
Total time on survey in all vessels	370 days
Time lost through unsuitable weather	100 days

APPENDIX I

PERSONNEL AND EQUIPMENT

Personnel. The personnel was restricted by the size of the boat to six persons, that is, the Officer in Charge of Survey, an assistant, three able seamen, and one motorman. During nearly the whole of the second season we did not have a motorman, one of the seamen acting in that capacity. This number was rather too small and we were often obliged to impress the cook of the day. In every respect the personnel came up to my highest expectations.

Equipment. The main item of equipment consisted of a *motor boat* 25 ft. in length with 7 ft. 6 in. beam, decked, with open cockpit, a 3-cylinder petrol engine of 21 H.P. giving about 6 knots speed when fully loaded. There was a fair amount of locker accommodation, and extra fuel space enabling us to carry 65 gallons all told.

She was, within the limits of her size, a good sea-boat and remained thoroughly tight, although the deck had to be recaulked occasionally. The engine gave little trouble, but was inclined to soot up at very low speeds. When sounding, owing to cold, she gave a little trouble in starting during the first season, but, later on using aviation petrol of low flash point, she always started well. We carried the sail for emergency, and could make good speed with a strong fair wind; the sail was always used with the engine when possible.

A bigger boat, if possible with twin screws, would have been an advantage for passages: on the other hand for harbour work, sounding, and so on, she was an ideal size, although owing to her high side rather unhandy in a strong wind. Some small alterations were, however, found to be necessary, apart from fittings such as brackets for the wireless telegraphy receiver. The principal change made was the addition of a canvas dodger or screen supported by small brass stanchions (see Plate XL, fig. 1), extending across the break of the deck and to the after-end of the cockpit on either side. This was essential; for without it the cockpit became very wet in anything but a calm. Later, a sloping wooden cover or canopy was built over the after-end of the cockpit to prevent her being pooped.

The mast was originally made to ship in a hole through the deck and step in the fore-cabin. It was found impossible to handle it in any sea—the very time when it was most likely to be required. Accordingly it was cut down and made a fixture, but swivelled to fold down towards the stern. It could then be rigged exceedingly quickly, especially as we kept the backstays permanently set up and the sail secured with a slip knot: the time taken to up mast and set sail was a few seconds, even in a rough sea. To counteract the extra strain on the deck at the mast step, the step was placed farther forward and the mast given a heavy rake aft: this gave it more lift and no undue strain was noticed on the deck beams.

The *Lucas sounding machine* was fitted aft on the starboard side (for the officer to read the dial easily), and the starboard towing bollard was fitted with a flat padded top for the leadsman to sit on. A light pedestal, about 2 ft. high, was made for the machine, and the leadsman was thus not compelled to bend so much and could do spells of half an hour or more of deep sounding without undue fatigue. Two machines, each of the 400 fathom size, were carried, and when fitted as described above, were found to work perfectly, unless very carelessly handled. The best weight of lead was found to be about 10 lb., but varied somewhat with the depth, owing to the decreasing leverage as the wire unwound from the drum. This was difficult to overcome, but if necessary a light touch had to be kept on the jib head to help ease the hand brake. Care of course was necessary when doing this, as, if the wire is allowed to overrun, a great deal of time is wasted in clearing it, and some wire is almost certain to be sacrificed. Various schemes were thought of to pick up bottom samples, but none were found to improve on the old-fashioned tallow arming, either in time saving (which is important when the soundings have to be kept equidistant) or in efficiency. The worst drawback was that the tallow froze iron hard; but a spare tin of it was kept on the engine exhaust pipe and changed every now and again. The tallow never failed to pick up bottom samples.

The *pram*, a 14 ft. boat, was always towed and was of course used for getting ashore. It was useful also during passage to carry an extra supply of petrol in drums. She was an excellent little boat, but floated like a saucer and was quite unmanageable in a breeze, having no keel; otherwise she was a very handy type, easily handled by one man, and light for hauling up on a beach. She was also used for shallow in-shore sounding, but was naturally both uncomfortable and difficult to keep on the line.

Four *fire extinguishers* were fitted: one in the cockpit at the helmsman's hand, one at each end of the engine room, easily accessible to the motorman, and one in the fore-cabin just by the engine room door. These precautions were fully justified, as during the first season, owing it is supposed to backfires, the petrol in the save-all under the carburettor caught fire on many occasions when starting, but was extinguished without difficulty.

A *sea anchor* was made and rigged, although it was never used in emergency.

The scope of *chain cable* supplied with the boat (10 fathoms ¼ in.) and a 30 lb. anchor were entirely inadequate, and would, in fact, be inadequate anywhere. Here 20 fathoms of ⅜ in. is the least that should be used, and even that, I am inclined to believe, would not suffice always. We invariably moored, except when the stop was temporary, with two 60 lb. anchors and 20 fathoms each of ⅜ in. cable to the most exposed quarter, and at least one other anchor in the opposite direction. During the first season we carried five 30 lb. anchors weighted with about 30 lb. of lead near the crown, 2 lengths of 20 fathoms ⅜ in. galvanized iron cable, 2 lengths of 20 fathoms ¼ in. cable, together with the original 10 fathoms ¼ in. cable. During the next season we had in addition one length of 40 fathoms ¼ in. cable, which was kept bent to the bower anchor. In the event of a breakdown nothing less would have been of much value, owing to the depth of water being often so great, quite close to the shore. Fortunately, we never had to use the

40-fathom length in the open, although we were several times compelled to anchor with it in sheltered water through some temporary breakdown.

The Marconi 4-valve R.P. 11 long-wave *wireless telegraphy* receiving set worked very well and enabled us to receive time signals from Nauen or Rugby practically when required. This set should be replaced nowadays by a short-wave set, because the receiver with its low and high-tension batteries took up a lot of space and was also very heavy for a small boat. The frame aerial also was rather too large for easy handling.

With the *instruments* numerous spares had to be taken, for we had no means of doing any but the simplest repairs. Duplicate theodolites and other delicate instruments had to be carried and kept in a safe place. Of the theodolites the most useful was one with a 3½ in. glass circle of the Tavistock type (see p. 306). The Admiralty theodolites were found rather cumbrous, as so much climbing had to be done and landings made on slippery rocks. They stand hard wear very well, however, and one that lay water-logged for some time and probably had many hard knocks when the 'Alert' went ashore, was cleaned and dried and found to be entirely undamaged. In these theodolites the leather covers for protecting the bare skin from the metal screws in cold weather were not found very useful, and wash-leather gloves are recommended to be worn instead. The leather is inclined to turn on the screws and thus cause delay when the fingers are already numb: the gloves both keep the cold off the fingers and protect them from the metal. For eyepieces wash-leather gummed on will serve, but non-metal eyepieces would be better.

Drawing boards of single wood were supplied. Although light and handy, they got very dry and nearly all split.

Beacons. Hop poles about 15 ft. in length are generally quite large enough for beacons, as they can be readily seen at a great distance if properly sited. Larger poles are heavy to carry if the ground is at all steep; they are also too large for the boat. Red and white flags were chiefly used, and of medium size, 9 ft. by 3 ft. approximately. Owing to the high winds encountered, larger flags put too much strain on the spun-yarn guys. A small amount of orange calico, which was taken to South Georgia for experiment, was very visible and might be used instead of red. When the background is rocky and has snow patches, white and red may blend with it, and a vivid orange is therefore best. Four-yarn spun-yarn is necessary for the guys, and of these at least four to each beacon are essential, with more on the strong wind side than the other. The anchor for the guys has to be left to circumstances, but a round turn around tussac serves very well, when available, as tussac is very tough. An iron bar with a point (a short crowbar) was always carried to make holes for the stakes in the frozen ground or ice; occasionally a point of rock could be used, but with this the yarn chafed if not protected. If possible, the heel of the pole should be sunk.

Tents, of which four were taken, comprised two light Antarctic tents, one Willesden canvas and one duck canvas. The best one for general use turned out to be the green Willesden, being more watertight than the others. It was, however, very stiff to pack, especially when wet, and very heavy; but as we packed the tent when wet in the pram, this did not so much matter. When snow but not rain was expected, as in the first half of the season and near the end, the Antarctic tents were best and handiest. These tents are of light material, silk mixed with cotton, and they are supported by four bamboo poles connected at the top with raw hide. They have no guys and there is a deep valance on which snow or shingle is heaped. The canvas duck tent was a very good compromise for general use (Plate XLI, fig. 2).

The *cooking* was always done in a separate tent, as the heat raised was negligible and the steam condensed on the inside of the tent and made it very wet.

Sleeping bags. These were double thickness Jaeger wool, with the usual flaps, and a detachable waterproof outer cover. They were very comfortable, but hardly warm enough. The waterproof cover was seldom used, because the condensation caused the bags to become very wet inside. It is suggested that it would be better to have had it in two pieces, the bottom and sides in one and an overlapping top secured by toggles like the head flap.

Clothing. Nothing special need be said, except that coats should be short (pea-jackets), because of the large amount of waist-high tussac that one almost invariably has to go through. Even in fine weather the tussac is often wet, and a long coat becomes waterlogged and is a nuisance. It is not easy to dry anything, except on the rare sunny days. Rubber sea-boots are in my opinion better than leather, though they are colder. They should have leather soles, as otherwise they wear out quickly on the sharp rocks, and they should be at least two sizes too large to allow for extra pairs of stockings. The astrakhan caps supplied answered very well.

Gloves. An inner, fairly loose wash-leather glove, secured at the wrist to prevent it slipping, should undoubtedly be worn; the touch is almost as good as with bare fingers, and yet the hand is protected against both wind and metal. Such gloves are useful with theodolite or level, and especially so with a sextant, when the hands have to be raised. Gloves are a difficulty in sounding, because even with a Lucas machine the hands are bound to get wet. An oilskin outer mitten with a leather pad held in the hands was found fairly good, although arming the lead caused some difficulty.

Primus stoves. These had always to be used for cooking, the amount of driftwood to be found on most beaches being negligible. If looked after and kept clean, they give excellent service, and as we generally used two, it was possible for the cook to prepare a meal for the five of us of soup, meat and vegetables, and coffee in not much over half an hour. Fresh whale meat was greatly appreciated when it could be obtained.

APPENDIX II

MAGNETIC VARIATION

Whenever an opportunity occurred, as at Stanley, Falkland Islands, the variation was recalculated, and with some unavoidable exceptions this was also done as a matter of course at all places where a regular survey was made.

The method was always the same. True bearings of a number of well-defined points (usually six) at more or less equal distances round the compass were determined from a solar observation and theodolite angles, or, as at Stanley, from a record of a previous determination. A round of bearings by compass, in our case a 6 in. Dover compass, was then taken and repeated left to right and in the opposite sense as often as considered necessary. The difference between these and the true bearing is of course the variation, and the mean of the differences tends to eliminate card and observational errors. By taking the compass bearing both ways, the errors of friction of the pivot and cap are cancelled. The final result, if carefully taken with a good compass, should be reliable, although of course the compass is only marked to degrees, and sometimes half degrees, and the minutes have to be estimated. The vicinity of any iron structure should, of course, be avoided and iron implements or knives, if carried, laid down at a distance.

Variations were calculated in the Falkland Islands at Stanley (three times), and in South Georgia at the following places: Undine, Larsen, Husvik, Leith and Prince Olaf.

No abnormal magnetic variation was detected at any place visited during the time covered by this narrative.

Table of results

Place	Date	Magnetic variation
Stanley, Falkland Islands	May 1926	9° 24′ E
Stanley, Falkland Islands	May 1927	9° 23′ E
Stanley, Falkland Islands	March 1929	10° 03′ E
Undine Harbour, South Georgia	December 1926	4° 21′ W
Larsen Harbour, South Georgia	January 1927	4° 16′ W
Leith Harbour, South Georgia	January 1927	4° 15′ W
Husvik, South Georgia	November 1928	4° 03′ W
Prince Olaf Harbour, South Georgia	November 1929	4° 36′ W

APPENDIX III

WEATHER AND CLIMATE IN SOUTH GEORGIA

During our commission in the 'Discovery' we had opportunities of studying the meteorological conditions. The experience gained was useful later, when it became a great deal more important, for in the 'Alert' we were largely dependent upon weather.

The usual meteorological laws hold good, that is, the wind commences with a falling barometer and blows from the northward (north-west or north-east, but usually north-west) and increases; then, when the glass ceases to fall, the wind gradually veers towards the west or east, depending on whether it commences north-west or north-east, and reaches its maximum force. Finally, the glass commences to rise and the wind continues to veer towards the southward, gradually dying down. Northerly winds bring moisture, rain or snow, and southerly winds dry and fine weather—exactly the reverse to conditions in the Northern Hemisphere. Following upon the above, the south-east end of South Georgia is very much drier than the north-west, no doubt because the wet north-westerly wind is deprived of much of its moisture in traversing the length of South Georgia, which lies with its long axis west-north-west and east-south-east. A further peculiarity of winds here is caused by the steep-sided glacier valleys which cut the island in all directions. The valleys remain in almost complete shelter until the wind has backed or veered to the direction in which they lie, and when this has occurred the full force of the gale is suddenly felt without any previous warning. An anchorage at the bottom of a valley lying north-west will thus feel the maximum effect of wind when the glass begins to fall and the wind to blow from north-westward, while, owing to the high mountains which bound the valleys, winds from other directions are kept off. A good example of this effect is Stromness Bay, with Leith Harbour (lying north-west), Stromness Harbour (lying west), and Husvik (lying west-south-west).

The temperature of South Georgia never falls very low, the least we experienced being just above 0° F. On the other hand, it is seldom higher than 60° F., and the average temperature is not much over freezing-point, summer and winter alike. Precipitation is fairly heavy in the north-west, decreasing eastward; the south-east probably has a much lower rainfall.

Snow continues to fall until midsummer (the end of December); but on the other hand rain has been known in mid-winter.

Gales are almost continuous, particularly in the spring and autumn. They are of considerable violence, which is increased by the glacier valleys mentioned above. On one occasion, in the 'Discovery', we were literally blown out of Cumberland Bay by a wind which reached hurricane violence, and when 10 miles out, the weather fell practically calm, although we could see the water smoke blowing out of all the fjords, stirred up by the violence of the wind. The whalers corroborate this: frequently when it is blowing hard in the whaling stations, the whale-catchers in their routine telephone conversations report much less wind out at sea.

Fog is exceedingly prevalent when the weather is calm, but perhaps more so during January than at any other time, and least in July. Frequently it does not penetrate into the fjords, and very often it does not extend for more than 30 or 40 miles, or even less, to seaward.

APPENDIX IV

NOTE ON KELP

The variety of kelp (*Macrocystis pyrifera*) found upon the coast of South Georgia seems to have one very marked feature, a feature noticed at Undine in the north-west, at Larsen in the south-east, and at every intermediate point so far examined both in sheltered and exposed situations. This is that in no case has it been found rooted at a greater depth than 14 fathoms low water (chart datum). In this respect it seems to differ from that found in Patagonia by H.M.S. 'Beagle', of which Darwin writes.

In South Georgia, owing to the steepness of the bottom, it was often found that although 20 or even 30 fathoms were obtained at the tips of the plant's fronds, the roots were invariably in 14 fathom or less. It appears that the kelp grows in as little as 1 fathom or less, but never very close to a shelving beach, owing no doubt to the continual wash of the surf. For the same reason the tops of breaking rocks have invariably been found to be quite bare, although often surrounded by kelp in somewhat greater depths where the water does not break. This is particularly so in more open water, where the waves break with greater violence.

The kelp only grows on a rocky or stony bottom and never on sand, mud, or even shingle, unless the latter is of large stones; this is of course quite understandable since it requires only a firm anchorage.

In fjords which contain a glacier, kelp is never found within a considerable distance of the glacier—often a mile or more. This is caused mainly by the ice which is constantly floating away from the glacier, but may be partly due to the freshness of the water.

It is reported, but not personally verified, that the kelp shows a considerable shrinkage in some of the harbours of South Georgia and also to some extent along the coasts, and I have formed the opinion that this is due almost entirely to the movements of vessels. The rate of growth of kelp during the close season cannot be sufficient to make up for the destruction caused during the remainder of the year, especially as it is not completely undisturbed even then. The rate of growth must nevertheless be considerable, as it was seen that some of the channels, such as those at Husvik and in Merton passage (Barff Point), had appreciably narrowed between May and September 1929.

King Edward Cove (Chart I), having a maximum depth of 11 fathoms with a gravel bottom, was apparently completely covered by kelp when first visited, but has now only a small fringe near the entrance. This disappearance must be due primarily to movements of vessels and has been helped latterly by the fouling of the water and the bottom by effluents from the whaling station. Although the depth was here not too great, the gravel bottom in the centre would be unsuitable and the kelp must have grown out from the sides. At Stromness Harbour kelp is reported to have extended over a considerable part of the harbour, though only a narrow strip round the shore is shoal enough for it to grow. We have evidence that the fronds grow to a great length, and though none were actually measured, some that we saw must have exceeded 100 ft. Ice undoubtedly destroys a great deal of kelp, but this cannot account for the shrinkage which has occurred during the past twenty-five years.

PLATES XL–XLIV

[illegible]

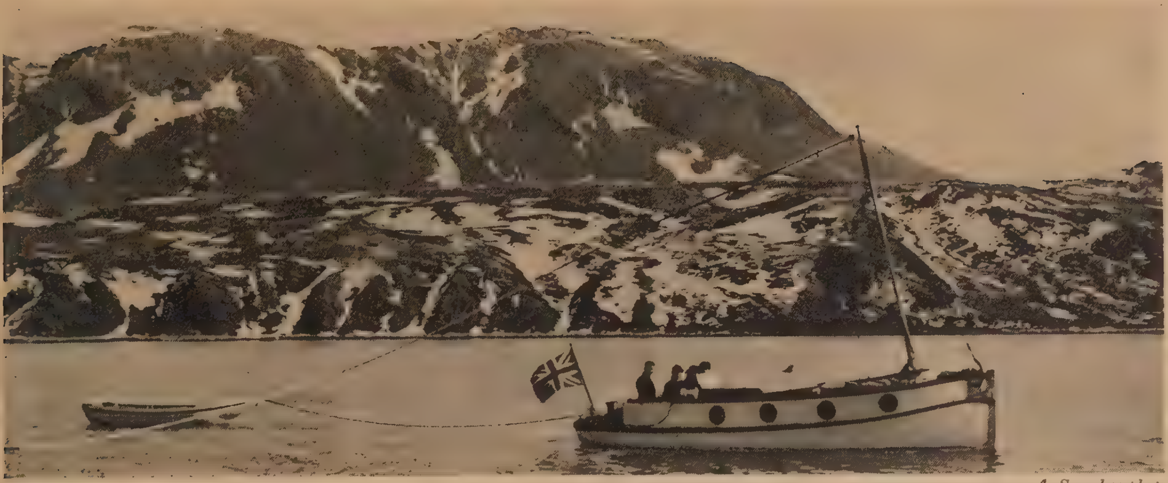
[illegible]

[illegible]

PLATE XL

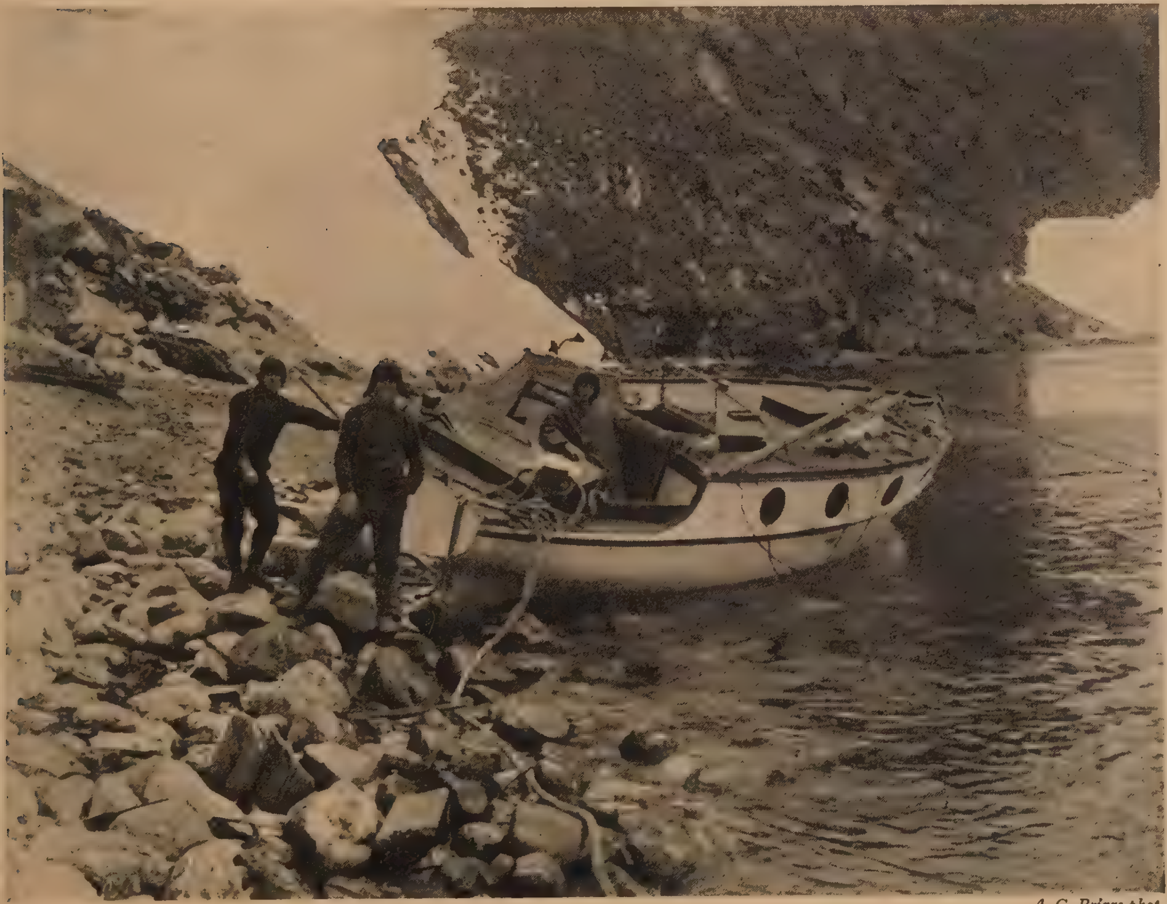
Fig. 1. Motor vessel 'Alert' under weigh in King Edward Cove, South Georgia.

Fig. 2. Motor vessel 'Alert' ashore in the Bay of Isles, South Georgia.



A. Saunders phot.

Fig. 1



A. C. Briggs phot.

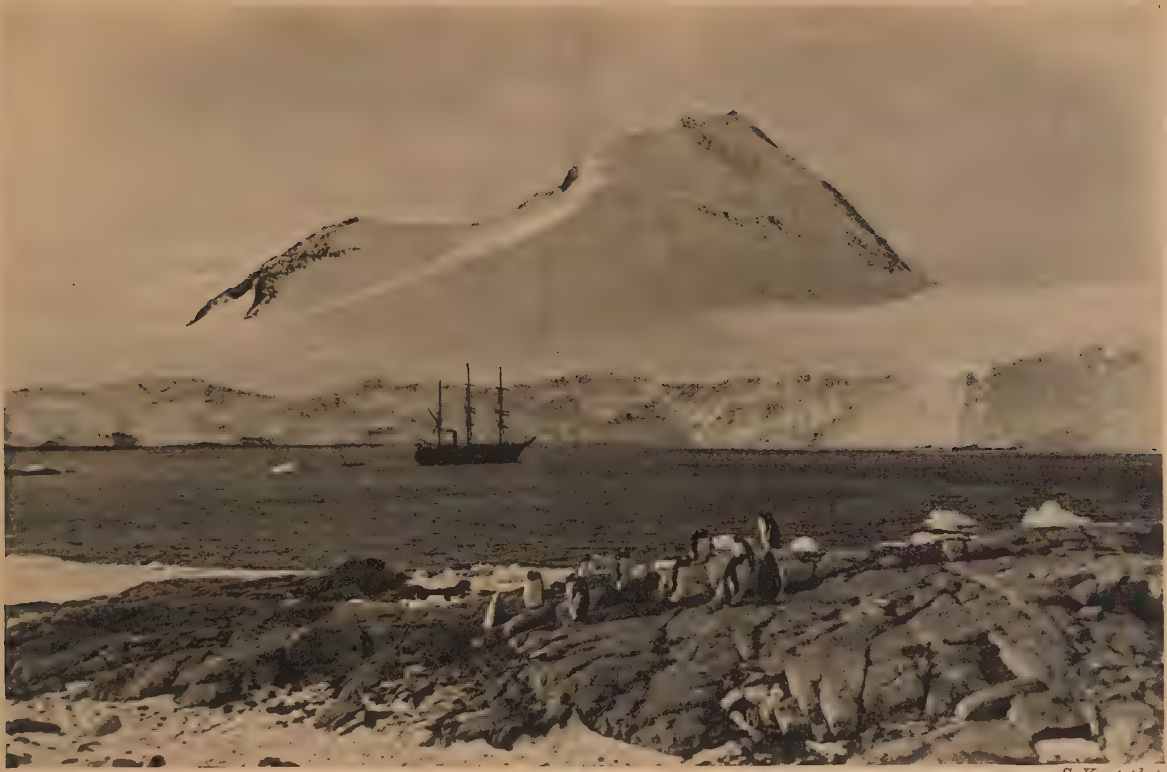
Fig. 2

MOTOR VESSEL 'ALERT'

PLATE XLI

Fig. 1. Port Lockroy, Wiencke Island, Palmer Archipelago. View looking north, with Noble Peak in background.

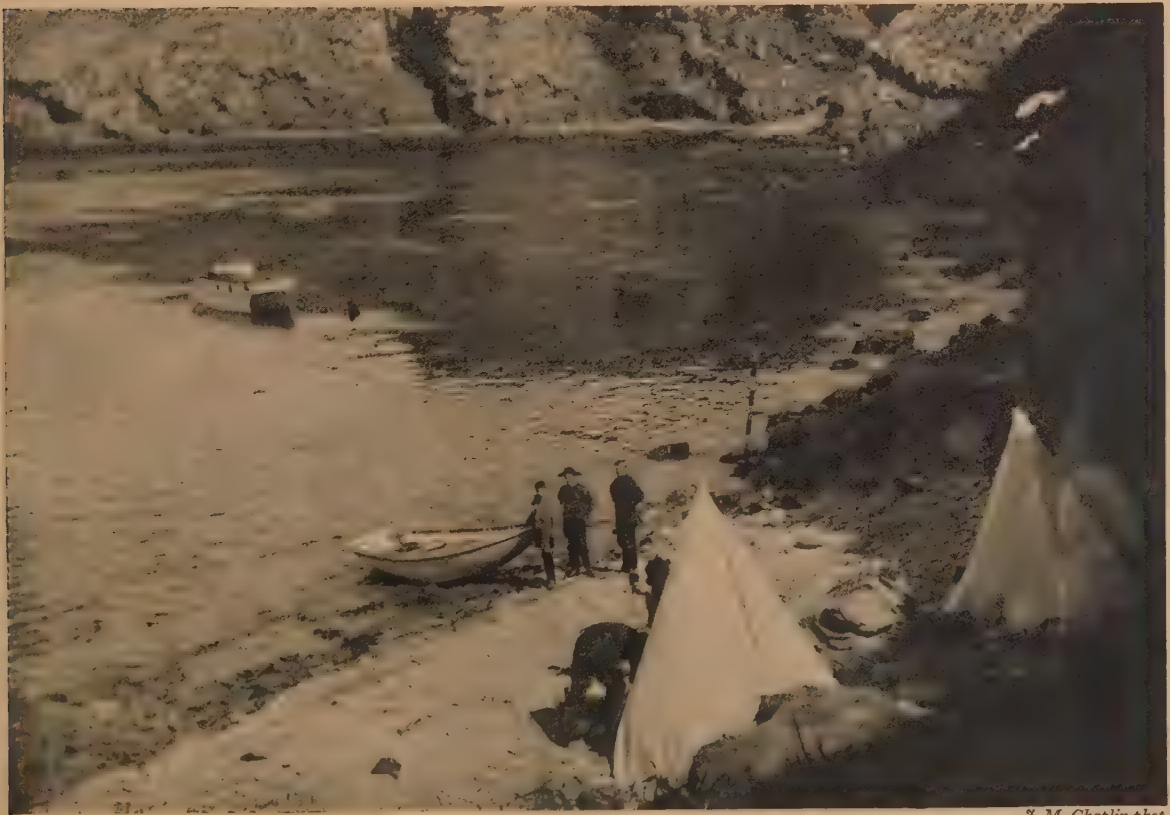
Fig. 2. Survey camp at Pleasant Cove, near Godthul, South Georgia.



S. Kemp phot.

Fig. 1

PORT LOCKROY, PALMER ARCHIPELAGO



J. M. Chaplin phot.

Fig. 2

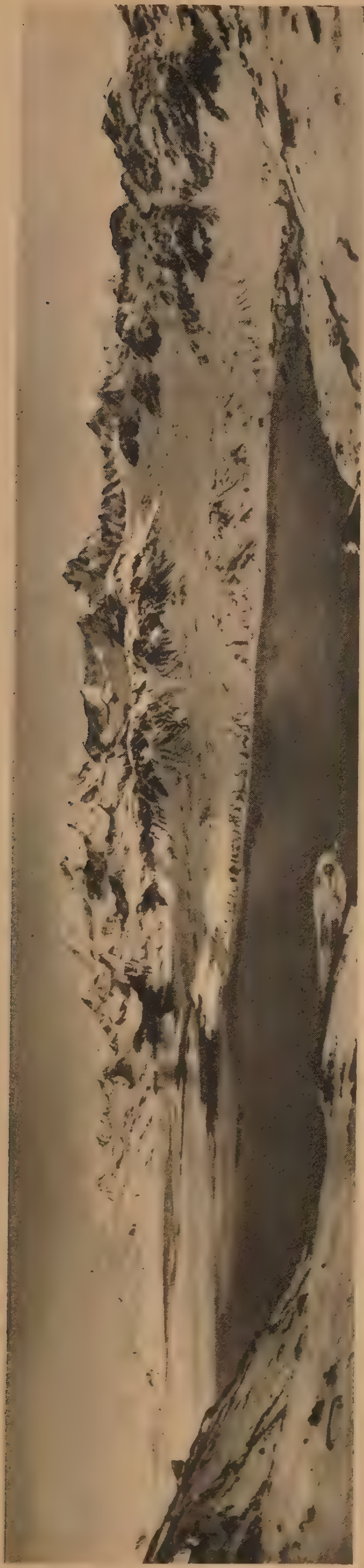
SURVEY CAMP, BAY OF ISLES, SOUTH GEORGIA

PLATE XLII

Fig. 1. King Edward Cove, South Georgia. Whaling Station on right, and King Edward Point with Government quarters and Marine Biological Station in left foreground. Mountain range in background with Sugarloaf Peak, 7500 ft., to right of centre, and Mt Paget, 9200 ft., to left.

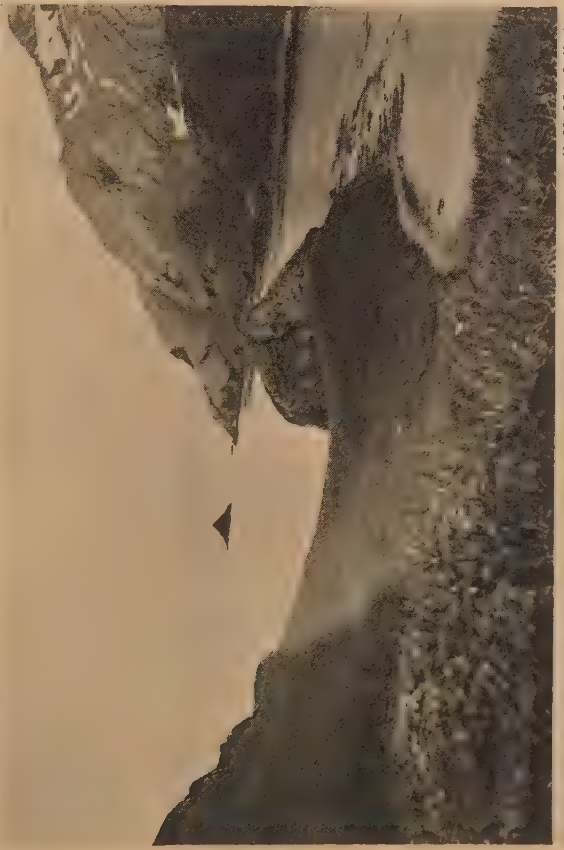
Fig. 2. Elsehul, South Georgia. View of entrance.

Fig. 3. Undine Harbour, South Georgia. O'Connor Island in middle distance; Cape Demidov in background on left.



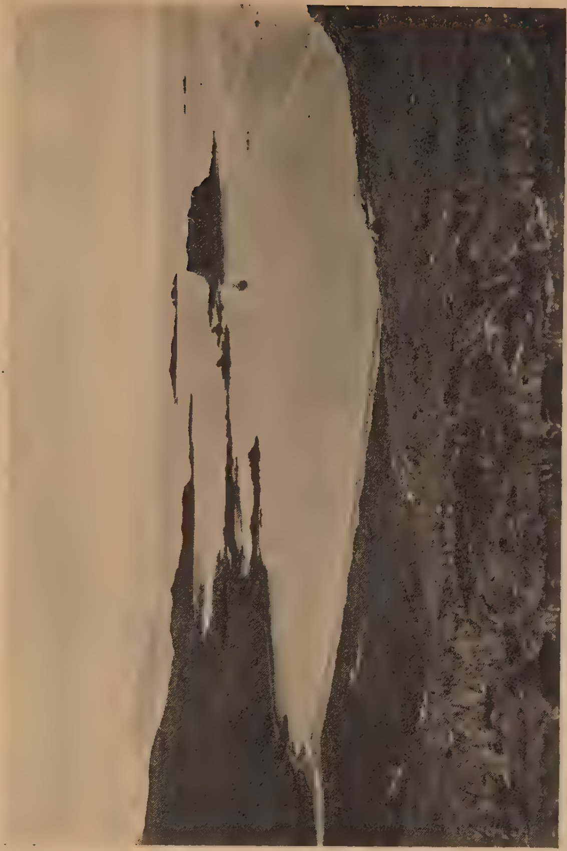
F. C. Fraser phot.

Fig. 1



E. H. Marshall phot.

Fig. 2



J. F. G. Wheeler phot.

Fig. 3

SOUTH GEORGIA

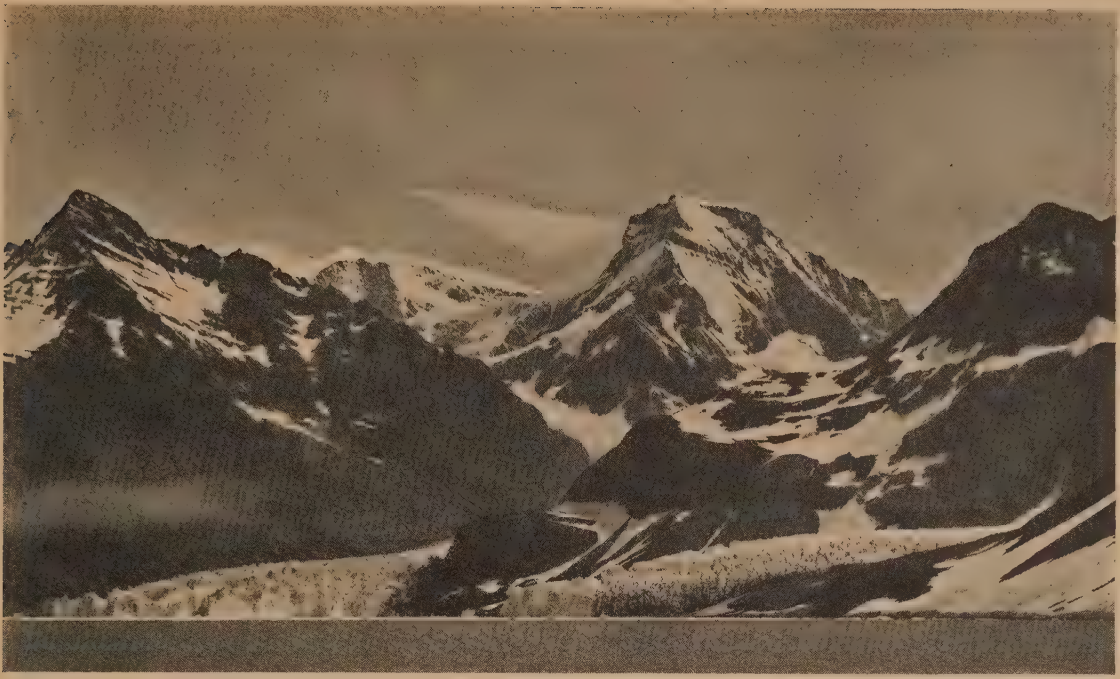
PLATE XLIII

Fig. 1. View at the head of Moraine Fjord, Cumberland Bay, South Georgia, showing the two glaciers. The peak in the distance lies between Sugarloaf Peak and Mt Paget.

Fig. 2. Morainic iceberg, seen near South Georgia, bearing a close resemblance to an island.

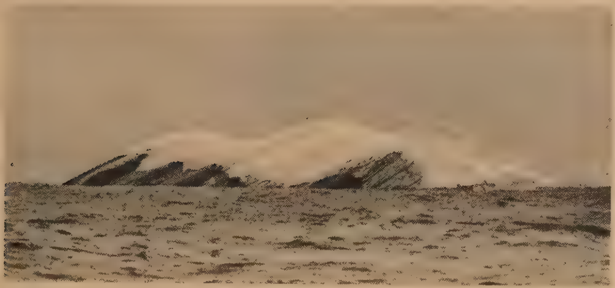
Fig. 3. Cape George, South Georgia, showing supposed former water-level some 80 ft. above that now existing.

Fig. 4. Barff Point, South Georgia, to left of centre, with Right Whale Rocks. Sugarloaf Peak, 7500 ft., in background.



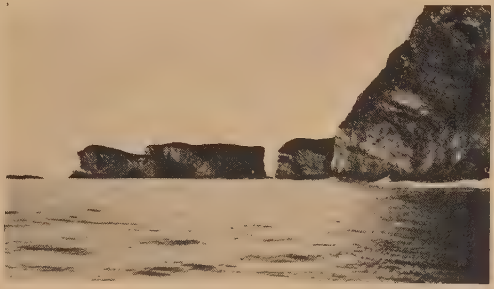
E. H. Marshall phot.

Fig. 1



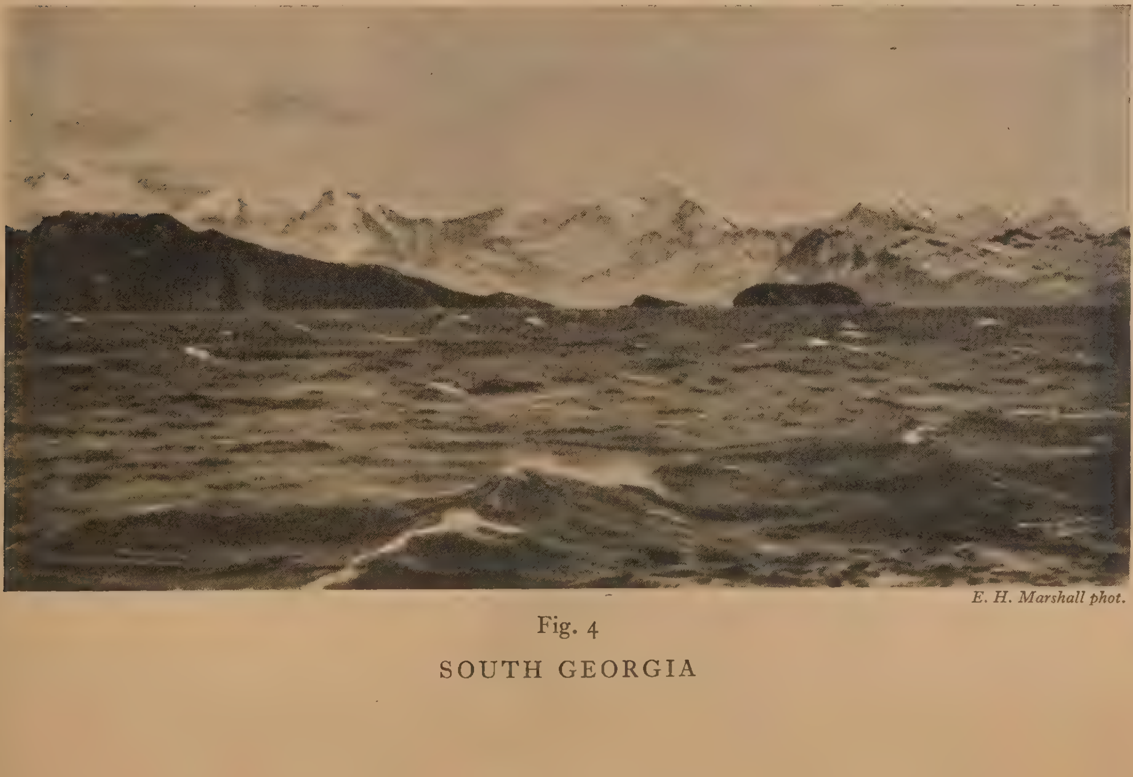
A. C. Hardy phot.

Fig. 2



G. W. Rayner phot.

Fig. 3



E. H. Marshall phot.

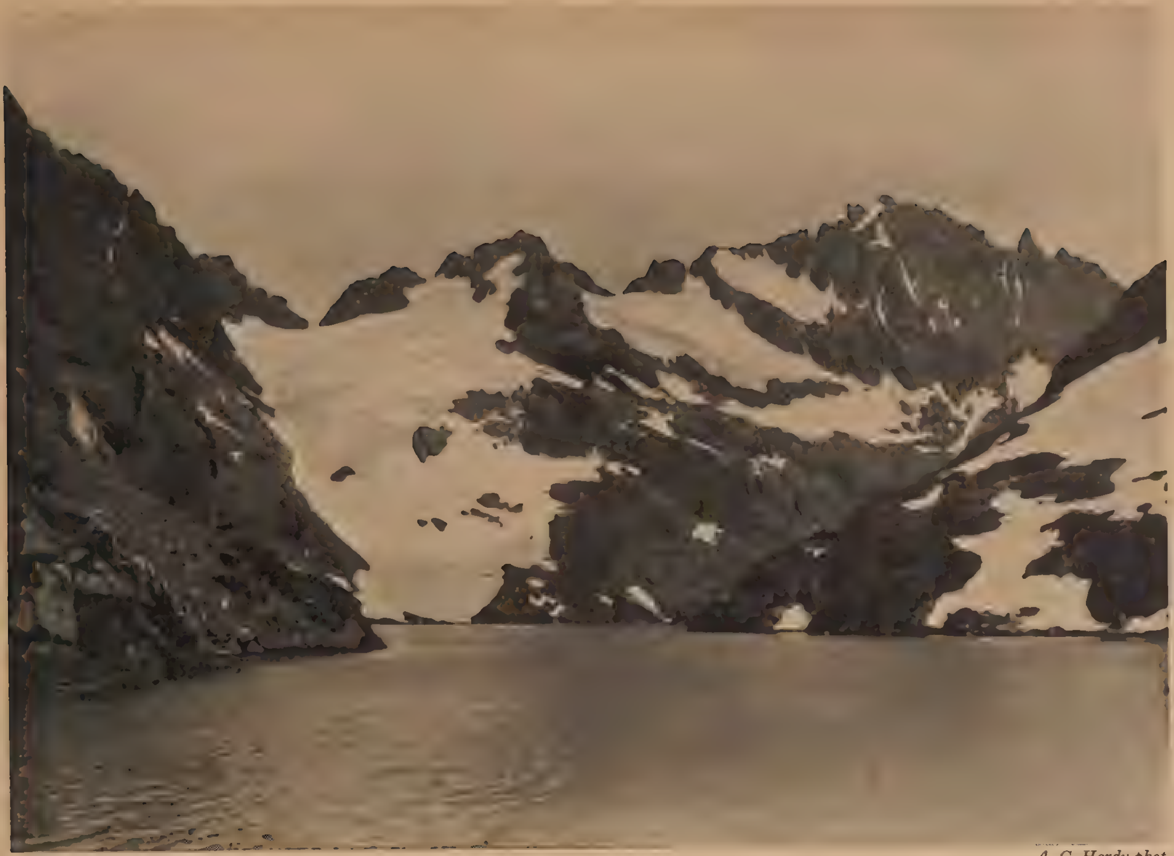
Fig. 4

SOUTH GEORGIA

PLATE XLIV

Fig. 1. Larsen Harbour, South Georgia, seen from the entrance.

Fig. 2. Coal Harbour, near Undine Harbour, South Georgia, to right of centre, with Snow Peak, 2700 ft., in background.



A. C. Hardy phot.

Fig. 1

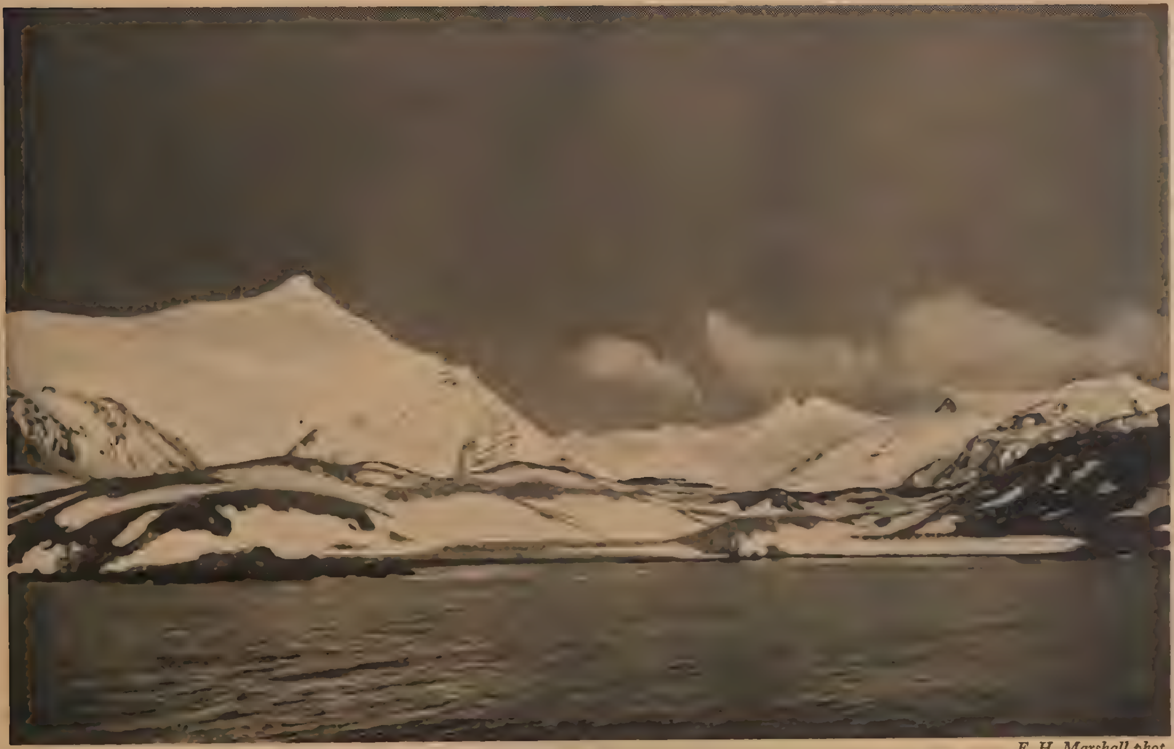


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Fig. 2

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